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The Farmer's Digest

From more than two hundred magazines and bulletins published in this country and abroad, the Editorial Staff of the Farmer's Digest selects articles of outstanding merit and general interest. It is comprehensive in its scope, covering all phases of Agriculture.

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EDITORIAL STAFF—Editor, L. Bush-Brown
Associate Editors—John A. Andrew, Jr.; C. Leavitt Dyer; R. L. Patrick, Ph.D.

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Recent Developments in Grass Drying

Condensed from Journal of the Royal Society of Arts

Lieut.-Colonel G. P. Pollitt, D.S.O., M.Sc., Ph.D.

THE drying of summer grass by the sun and wind, that is, haymaking, is one of the oldest of the agricultural arts. The drying of grass by artificial means, that is, by the use of coal or coke, is of very recent date, and a great deal of interest has been aroused in this question.

The first experiments were made in this country (England) in 1926.

The British Isles are ideally situated for producing the finest permanent and rotation grass in the world; with the possible exception of New Zealand no other country is so well placed in this respect. There are twenty million acres of grassland in Great Britain, and of these six million are cut for hay and the rest used for grazing. At the present time this grassland is used far below its real production capacity. It is understocked because farmers cannot feed their stock all the year round. It is insufficiently manured, because farmers are unable to cope with the seasonal flushes of growth, and the produce is largely wasted because no satisfactory method of conservation has hitherto been employed. With proper management, this grassland can give a greatly increased yield. Generally a farmer has too much grass in early summer, and he rarely fertilises it because this would increase the surplus. He cannot buy more stock to eat it, because he could not keep the animals during the remainder of the year without buying in large quantities of other foods. Haymaking cannot enable us to conserve this surplus grass, either the spring grass or the grass which grows abundantly from August to November on well fertilised land. The losses of food entailed by haymaking are very great. When the grass is young and leafy, that is, when it contains its highest food value, weather conditions prohibit haymaking. The grass has to be allowed to grow to a more

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mature condition, by which time its food value is greatly decreased. In addition, in the actual process of haymaking, biological changes take place which reduce the food values, and in a good year at least 25 per cent of the food is lost. In a bad year, the loss is frequently nearer 70 per cent. Further, hay can never take the place of concentrated foods owing to its bulk. An animal cannot eat enough of it to obtain the food constituents required for its milk or beef production.

Silage can be made from grass, and this is better than haymaking from the point of view of food conservation. Even so, silage as at present made is often of relatively low feeding value; and experience has shown that the making of good silage is difficult and farmers generally are not attracted by it.

Artificial drying is the one method that enables a farmer to save all the protein and starch produced by his grassland, and in a concentrated form. If he has a drier, the farmer can, and will make his grassland yield the maximum amount of food, because all grass not required for grazing can be conserved for use in winter. Farmers normally sell a large part of their arable crops for cash, and these are the crops of highest feeding value. They are left with bulky foods, such as hay, straw and roots, which are low in feeding value, particularly protein, and unsuitable by themselves for producing milk or meat. Therefore, from October to April, when grazing is no longer available, the farmer has to buy starch and protein in the form of cakes, meals and milling offals, which come directly or indirectly from abroad. With artificial drying a farm can be self-supporting in foodstuffs, and grass is pre-eminently suitable for drying. An acre of grassland, farmed well, will easily produce 10 cwt. of protein and 35 cwt. of starch in a season. Compare these figures with the amounts produced from an acre of other farm crops:

Yields of Total Protein and Starch Equivalents from Farm Crops

	Yield per acre under good farming conditions		
	Weight of Crop	Total Protein cwt.	Starch Equivalent cwt.
Dried grass (3 or 4 cuts)	3 tons	10.2	34.8
Hay (one crop)	1½"	2.7	9.3
Oats (grain and straw)	7 qrs.	2.6	17.3
Barley (grain only)	5 "	2.0	14.3
Wheat (grain only)	5 "	2.7	16.1
Mangolds (roots only)	30 tons	7.2	37.0
Swedes (roots only)	20 "	5.2	28.0

Although mangolds and swedes give high total yields of protein and starch, they contain 90 per cent of water and must be supplemented by richer foods.

On my own farm I obtained 12cwt. of total protein per acre from one field in the dry season of 1935, from permanent grass which was cut and dried. In Ayrshire, at the Hannard Dairy Research Institute, 16 cwt. of protein and 65 cwt. of starch have been obtained in a similar way. You see, therefore, that grassland is outstanding as a source of protein and starch. But it has other feeding qualities which place it in a class by itself. Fresh young grass contains about 9 per cent of minerals and a high proportion of carotene, the yellow pigment which animals and human beings convert into vitamin A. The qualities are not lost in drying.

Grass is, in fact, the most complete and perfect food for farm animals. It is strange that it has taken so long to realise this; and but for the brilliant work of the late Professor T. B. Wood and Dr. H. E. Woodman, of Cambridge University, we should probably still be in ignorance. In 1926, Dr. Woodman, after pointing out that young grass is comparable in food value to concentrated cakes, showed that this value could be preserved almost intact by artificial drying, and that this dried grass would fatten cattle and produce milk. A decade passed before grass driers were introducted on a commercial scale, and immediately there was rapid expansion. Eight thousand farmers attended the first three public demonstrations of grass drying in 1936, and I doubt if any development in agriculture in our time has aroused such interest. In the spring of 1935 there were six grass-drying plants working in Great Britain. A year later there were 25, and this spring there are approximately 70. Over 70 patents have been applied for in connection with grass drying in the last two years.

The grass is ready to cut when it is about 8 inches high, about one-third the length at which grass is cut for haymaking. It is cut with a special machine which elevates the grass into a truck drawn behind, or alternatively with an ordinary grass cutter, and then raked and picked up by hand into bogies.

The drier I use, like the majority of small driers on farms in Great Britain, works at low temperatures not exceding 150°C. The water it removed by a current of hot air at about this temperature, which is forced or drawn through the grass.

The dried grass is compressed into bales which can be stored indefinitely. Some producers grind their grass into a meal,

particularly for poultry or pig feeding. In 1936 we made over 350 tons of this dried grass to feed in winter.

Farm driers such as these will, of course, dry other crops besides grass, and in districts of low rainfall they are used to dry lucerne, which also gives a high-grade concentrated foodstuff similar to dried grass. A grass drier is simply a machine to evaporate water, and the problem has been to devise equipment at low cost to do this economically and simply. Fresh grass growing in the field may contain as much as 90 per cent of water or as little as 50 per cent. It has to be dried until it contains about 3 or 4 per cent of water, and this means that to produce 1 ton of dried grass it may be necessary to evaporate nearly 9 tons of water, or in dry weather as little as 1 ton. This percentage of water is the dominating factor in the cost of drying. 1935 was a comparatively dry season, and on the average the drier evaporated about 3½ tons of water to produce 1 ton of dried grass. In 1936 conditions were very different, and as a result of the continual rainfall and lack of sun to remove dew, the drier had to evaporate over 5 tons of water for every ton of dried grass. This added enormously to the costs, because with fuel and labour at present prices it costs roughly 12s. to evaporate one ton of water.

I am satisfied that I can produce dried grass at under £5 per ton, making full allowance for everything except rent, and in a good year I should expect my cost to be about £4. This is a very attractive cost. These costs can be achieved by any farmer after a little experience in working his dryer. As to capital cost, dryers now available range from £1,800 erected down to £500 erected. The production of dried grass from these machines varies from 2 to 5 cwt. per hour, if the grass for drying contains an average amount of water. The higher-priced driers are designed to reduce labour charges and fuel consumption, and in choosing a

The Percentage of Minerals and the Carotene Values of Farm Crops

	Percentage of Minerals	Carotene Value Milligrams per kilo dry matter
Dried grass	8.6	250 to 500
Hay (good)	6.2	30
Oats (grain only)	3.1	Nil
Mangolds	0.9	"
Swedes	0.7	"
Imported Cake (e.g., Palm Kernel)	3.8	a trace

machine each farmer must take into account his own particular conditions.

What is the value of dried grass to the farmer? This can be arrived at by calculating the amount of purchased cake it will replace, plus an added value for the vitamins and minerals which are present in the dried grass but not in the cakes. A ton of good quality dried grass (17 per cent protein, 58 per cent starch equivalent) is worth, merely on its replacement value, £6 10s. a ton. The cash value of the minerals and vitamins in the dried grass may be debated, but I place it at a conservative figure of £1 a ton, and this gives a total value for dried grass of £7 10s. a ton. But to get a true picture of the financial side of grass drying, one must think in terms of the season's production. The average drier will easily produce 200 tons of dried grass in the season. The quality of this grass will vary considerably, but its starch and protein content would save the farmer £300 to £400 normally spent on cakes or meals. This immediate saving on starch and protein is not the only advantage. It has been found that feeding dried grass to stock raises the standard of health to a higher level. Under present systems of feeding, animals are changed over from grass to indoor feeding, and back again, each year. The general standard of health and condition is gradually lost during winter, and regained when grazing starts once more. The improvement brought about by feeding grass all the year around will, I believe, have a considerable effect on the livestock balance sheet, and that is why I value the minerals and vitamins at £1 a ton.

My own experience in fattening bullocks for show or slaughter leaves no doubt that a ration of 10 lb. of dried grass (17 per cent total protein) with unlimited oat straw will fatten a young animal at the rate of over 2 lb. live weight increase a day and produce a very high quality carcase. Animals fed on dried grass grade well, and the quality of the meat is the same as that from cattle fattened on pasture.

There is more information available on feeding dried grass to milk cows than there is in connection with any other class of stock. Milk producers have quickly realised the advantages of dried grass. And retailers know the value of dried grass in maintaining summer colour of milk throughout the winter. We know from experience at Jealott's Hill Research Station that cows yielding up to 4 gallons of milk a day can be fed with complete success with dried grass as the sole concentrated food. There are at least 15 dairy farms where dried grass has been fed this winter, and

first reports indicate substantial savings in the purchase of concentrated food, together with improved health of the cattle and higher quality of milk. An outstanding demonstration of the value of dried grass in milk production is afforded by Dairy House Farm, near Middlewich, Cheshire. This farm of 170 acres carries a milking herd of 60-70 head, and has a grass drier. Since the autumn of 1935 these cows, together with heifers and calves, have had practically no home-grown or purchased concentrated foods other than dried grass. Milk yields have been maintained, the condition of the herd is excellent and the colour of the milk has remained practically uniform throughout the year. Grass drying has made the farm almost completely self-supporting in foodstuffs for cattle.

I should like to emphasise that my own experience shows a great difference in the relative fattening value of dried grass of different protein percentages. In 1936, owing to the wet seacon, driers could not keep pace with the growth of grass, and I, in common with many others who were drying, made the mistake of drying grass when it had grown too long to be of maximum feeding value. I should have cut fewer acres more frequently to obtain higher quality. As it was, large quantities of grass were dried of a total protein content of about 14 per cent. Though an excellent food, with all the advantages of high vitamins and minerals, this 14 per cent grass cannot replace completely the more concentrated foods available for fattening stock. In the case of milk cattle, however, this lower grade grass will apparently replace concentrates up to 4 gallons.

On the fattening of sheep with dried grass there are no numerical data, but the Cumberland and Westmorland Farm School and Jealott's Hill Research Station have obtained very satisfactory results from feeding dried grass to ewes, both before and after lambing. The dried grass has increased the milk yields of the ewes, and this benefit has been passed on to the lambs.

The pig, being a non-ruminant, requires concentrated foods low in fibre, and as the majority of pigs are fed indoors they readily succumb to deficiency diseases which are largely due to not having access to natural foods. Experiments by Dr. Woodman have shown that the inclusion of 2 per cent by weight of a high-grade artificially dried lucerne meal in the ration will keep pigs healthy and thriving. Probably the main use of dried grass in pig feeding will be to supply protein and the essential vitamins and minerals, and quantities up to 15 per cent by weight of the total food can be

used. This applies to all classes of pigs, but especially to breeding sows and young pigs.

Imports of sun-dried lucerne meal from South Africa, Canada and elsewhere total 20,000 tons a year, and the greater part goes to poultry keepers, but imported sun-dried lucerne rarely contains more than 10 per cent of the vitamins present in dried grass. Experiments at the National Institute for Research in Poultry Husbandry, and other centres, have shown that feeding dried grass to intensively housed birds improves the colour of the egg yolks. Up to 30 per cent of the dry weight of food for poultry could usefully take the form of dried grass meal.

Some people think that factory driers serving a community, or mobile driers moving round the countryside, will be of most help. But there are drawbacks to either of these schemes. It is true that on the Continent and in America, where lucerne or grass drying is also developing, they prefer large driers of the factory type which require a capital outlay of £5,000 upwards and need skilled engineers. I doubt if these driers will establish themselves here. From the nature of our farming it is probable that progress will continue along the lines of one drier for each farm. The present types of driers require at least four men to keep them supplied with grass and for drying.

Grass drying is a seasonal job, but it fits in well with other farm work. It can stop during corn harvest, and continue again during September and October.

Three Distinct Stages Traced in the Growth of Fruit

Condensed from Farm Research

H. B. Tukey

IN the case of the peach, cherry, apricot, and plum recent studies have shown that there are three separate and quite characteristic periods of growth. The first of these, designated stage I, occurs immediately following full bloom and is characterized by very rapid enlargement of the fruit for several weeks. For the sweet cherry it is approximately 17 days, for the sour cherry 22 days, and for the peach 49 days. During this period the fruit is soft thruout and the stone or pit has not begun to harden.

Then, the fruit suddenly stops growing and there is a period of delayed fruit development, designated stage II. All fruit growers recognize this stage clearly when the fruit "seems to stand still awaiting a rain." As a matter of fact, rain has very little to do with the development of the fruit during this period. It makes little increase in size, regardless of summer rains. Careful measurements of the Elberta peach day after day will show that it does not increase in size a fraction of an inch for several weeks during this period.

Almost as suddenly as the fruit stopped in its first rapid increase in size, so it later begins a second rapid increase extending to fruit ripening. This period, near the end of the season and just before maturity, is often spoken of as the "final swell" and is stage III in fruit development. An abundance of moisture helps materially in sizing of the fruit at this time.

These three stages af growth are not only characteristic but significant. During the first period of rapid fruit development following full bloom, the cellular structure is laid down. Later in the season these cells may increase in size, but the foundation of the structure is completed soon after full bloom. This means that the cellular material which is to constitute the structure of the fruit at maturity must be readily available for growth in the early part of the season. Since it is in the foliage that these materials are manufactured, the importance

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of good foliage and damage to foliage from insect and disease attack or other mechanical and climatic causes are emphasized.

An interesting point about the first period of rapid fruit development is that it is nearly identical for all varieties within a given class of fruit regardless of whether they ripen the fruit early or late. That is, all varieties of peaches ranging from the early Greensboro to the mid-season Elberta and to the late Chili cease growing about 49 days after full bloom.

On the other hand, the duration of the period of retarded development varies strikingly with the different varieties, and is correlated directly with the season of fruit ripening. The Greensboro peach which ripens early is arrested in development for only 5 days and then begins the final swell. The Carman peach, which ripens soon after Greensboro, is delayed only 10 days; the Elberta peach, which ripens in mid-season, is delayed 35 days; and the Chili, which ripens quite late, hangs to the tree with no increase in size for 42 consecutive days. In the case of the sour cherry, Early Richmond is delayed only 5 days before the onset of the final swell; Montmorency, which ripens in mid-season, is delayed 12 days; and English Morello, which ripens late, is delayed 28 days.

These facts are fundamental in the intelligent thinning of fruit. it can be seen at once that if an early-ripening variety like the Greensboro is to be thinned, the work must be done early since there is only a short period of retarded development; whereas with Chili, which has a period of 42 days of retarded development, the thinning operation can be carried on much later in the season, yet with results beneficial to the size of the fruit.

The increases in size of fruits during the period of rapid growth are startling. Between the fourth and the eighth days after full bloom the surface area of the sour cherry increases 50 percent a day. During the final swell the increase may be 107 percent in nine days. During the final swell the fruit is doubling its surface area in a little over a week. As for volume increase, the figures are even more striking. Between the fourth and the eighth day following full bloom the sour cherry increases 100 per cent a day. In the final swell of the Montmorency cherry before fruit ripening the increase is 109 percent in nine days. At certain times, when growth conditions are favorable, the fruit may actually double in size in three days.

The application of these findings is obvious. Since, for example, the final swell is largely an intake of moisture, emphasis is placed

upon the importance of humus, cover crops, and good orchard management so as to retain moisture in the soil and retain the trees in good vigorous condition during the period of the final swell. Other applications are too apparent to need further comment.

During the first period of rapid development of the fruit (stage I), the embryo, which is the part of the seed which when planted out develops into a new peach tree, remains microscopic in size. In the case of the peach the embryo may remain microscopic for 49 days, whereas the fruit is making rapid increase. Then, just after the fruit enters the stage of arrested development (stage II), the embryo begins a very rapid increase. While the fruit took its turn in growing the embryo remained quiescent. Now the fruit remains quiescent and the embryo makes a strikingly rapid growth to full size in a very few days.

It is during this period also that the pit hardens. Cut open a peach or a cherry in early midseason before the pit has hardened. You will find that the pit is outlined in the flesh and that the seed structure has reached maximum size, yet no embryo is visible. A few days later, an examination of fruits will show that the pit has hardened, that the embryo has grown so rapidly as almost to fill the seed coats.

In the case of early-ripening varieties in which the fruit has a very short period of retarded development, the embryo is making its most rapid growth at just the time that the fruit begins the final swell. The result is abortive embryos and poor seed. These facts are of great interest to the plant breeder and to those interested in developing new early-ripening varieties.

Crop Testing Plan

Condensed from Kansas Farmer

Tudor Charles

THE Crop Testing Plan originally was used in Canada. Its purpose is to show by actual camparison the possibilities of improvement in wheat quality by wider use of better varieties and pure seed. Dr. John H. Parker, plant breeder at Kansas State College, brought Major G. L. Strange to Kansas for last winter's Farm and Home week, to explain the plan he originated in which 30,000 Canadian farmers are now taking part. After yields are taken on the farmers' plots, and the grain is threshed for examination and milling tests, the former owner of every sample of seed will get a card stating that his wheat graded either A, B, or C, and giving the reasons why. "A" means the seed is good, from the standpoint of both miller and farmer. "B" will mean that the seed will do, or is fair. "C" indicates that new seed certainly is recommended.

The Hogan Milling Company and Paul Gwin, Geary County agent, took over the job of starting the Crop Testing Plan in Kansas. It is expected this idea will grow and be used widely, because it is such a simple and inexpensive way of checking up on individual farmers' wheat varieties and of showing them side by side with other wheat grown locally.

A cross section of Geary county wheat fields was seen by the farmers, millers and grain men who viewed results of the new Crop Testing Plan on Wheat Field Day near Junction City.

One hundred an six farms were represented by tiny plots of wheat, only 8 feet long. Last summer at wheat marketing time, the Hogan Milling Company of Junction City, collected samples of seed from that many different farmers' wheat. The samples were seeded on the little farm of the Hogan company just southeast of Junction City.

Before the field day, every farmer had received a card from Paul Gwin giving him the number of his test plot. He could then inspect his wheat, if he wished, without anyone else knowing to whom it belonged.

The first thing Wheat Field Day visitors saw as they came into the crop testing field was a row

Reprinted by permission from Kansas Farmer, Topeka, Kansas

of the standard wheat varieties grown in Kansas, seed for which was supplied by the college experiment station. Then there were 106 different plots, only 2 by 8 feet, which represented the wheat grown on that many Geary county farms. Thruout the farmers' plots there were scattered check plots of Turkey and Blackhull wheat, the hard wheat varieties of greatest acreage in Kansas. After these plots, 80 samples of crosses made by Dr. Parker were exhibited.

It is not new to see the standard varieties growing side by side in test plots, but to be able to walk 100 yards and see close to 10 per cent of the various kinds of wheat grown in a county is striking.

Rye in wheat was one of the noticeable failings of individual samples. It is a serious menace in Kansas, and seems to be more prevalent this year than for a long time. Wheat which contains rye is commonly docked 3 cents a bushel by grain buyers if it is noticeable. It lowers the quality of flour and cannot be removed. Use of rye for emergency pasture after the summers of 1934 and 1936, undoubtedly has been the reason for much increase. At any rate, farmers were able to see how much rye is present in Geary county wheat, and it is expected this will result in much buying of pure seed to help get rid of it.

Mixed varieties were very noticeable in some of the plots. Not only was there evidence of mixed hard wheats, but there was considerable beardless soft wheat with the bearded hard wheats. Mixed wheat commonly carries a price dock of 1.5 cents a bushel. Last year about 1,500 carloads of mixed wheat were shipped from Kansas points. Figuring 1,500 bushels to the car, this makes a price loss of $337,500 on this wheat alone. Pure wheat will eliminate this loss.

Mis-named varieties were evident in several cases. One farmer had reported his wheat as Blackhull, but it really was Early Blackhull, and the two are "different as day and night" according to Dr. Parker. Another farmer who thought he had Tanmarq, really had Kawvale, when his plot was examined.

All of the plots carried a number and the name of the wheat as reported by the owner of the seed. Some were simply called mixed, others named two definite varieties. A majority of the plots carried one definite name, and showed marked characteristics of that variety, but not more than half proved to be pure strains without mixture or rye.

Another figure on the plot stakes gave the "doughball time." This is a new test to determine gluten strength, which was used

in the Middle West for the first time last year. Some of the hard wheats, which are preferred for making flour, have a breaking time of about 150 minutes on the average, while soft wheats are usually 40 minutes or less. Tanmarq shows the longest time. A few plots ran as high as 200 minutes. Turkey wheat is usually about 70, Blackhull about 60. These "doughball times" were determined from part of the sample of farmers' wheat taken last summer.

The purpose of the Crop Testing Plan is to improve wheat. There is need for still more effective work in breeding better varieties, production and distribution of pure certified seed of adapted varieties, reduction of amount of rye in wheat and mixed wheat, control of stinking smut or bunt, and many other problems. Possibly the Crop Testing Plan, as it is worked out and put into operation at many points, will prove an effective means of doing this thing.

Breeding Dairy Cattle

Condensed from The Jersey Bulletin

F. W. Atkeson

Kansas State College, Manhattan, Kansas

IN breeding dairy cattle we have two objectives, improved type and higher production. Of the two, production is the more universal problem of purebred and grade cattle breeders alike. Fortunately we have a rather exact measure of the results of breeding for production. The milk scale and the Babcock test give us the facts.

It was only thirty-five years ago that the first purebred dairy cattle breed association initiated an advanced registry system of record-keeping. In November, 1911, the first cow in the United States produced over 1,000 pounds of butter fat. Today the breed associations boast of 269 records over 1,000 pounds of fat or over six times as much as the average cow of the United States. One hundred and fifty-five records of 30,000 pounds or more of milk have been made. This is an average of over nine gallons per day for each of the 365 days. The highest record for fat is 1,329 pounds, and the highest for milk

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is 37,381 pounds. It would seem great progress had been made, but let us turn the page and look at a little different picture.

How much has the average production per cow increased? In the United States the average was 154 pounds in 1910, 146 in 1920, 177 in 1930, and 158 in 1934.

Why this great chasm of differ ence between the two pictures? Have we made progress or have we not? Yes and no, mostly no. Are there some hopeful signs? Yes. The Dairy Herd Improvement Association members have consistently maintained much higher average production in their herds than the general average. For example, in 1934, the United States general average was 158 pounds, while the Dairy Herd Improvement Association average was 322 pounds. We must bear in mind, however, that any testing program is not a substitute for a breeding program, but rather a measure of the previous breeding program.

In the past we have been contentedly coasting along on a philosophy exemplified by such catchy phrases as "Like Begets Like," "Breed the Best to the Best," etc. We have all seen many examples of a breeder becoming famous because of the fortunate selection of a certain bull, and other instances of great herds being ruined by only one bull. We have selected registered bulls; we have selected bulls out of cows with good records; we have in a few cases, even dug a little extra deep into our pocketbooks to buy a bull out of a cow with a record of 700 or 800 pounds of fat. Yet, in general, the disappointments have been too frequent and the predictions of the future too inaccurate. Something has been wrong with our system of breeding.

Let us study the results obtained by breeders of Holstein-Friesian cattle in the herd improvement test in which every animal in the herd must be tested. All records are quoted in terms of 365day records on three-times-a-day milking.

Of 11 bulls mated with cows averaging over 600 pounds of butterfat only two increased production. In the class of cows averaging 550 to 600 pounds, 3 of the 15 bulls increased production. Similarly, 24 out of 46 bulls increased production in the 500-550 group of cows, 27 out of 63 bulls in the 450-500 group of cows, 42 out of 64 in the 450-500 pound group, 31 out of 41 in the 300-400 pound group, and all of the 9 bulls in the 300-350 pound group. Only slightly over half, 55 per cent of all the 249 bulls increased production. When we consider the data were obtained from the better purebred herds of the United States, these facts confirm

the deduction that something has been wrong with our breeding program in the past.

But that is not all the story. Let us go further and convert the records of the cows from the 365-day three-time-milking basis into ten-month records on twice-a-day milking. The results then become appalling. Only 5 of the 26 bulls increased production when mated with cows averaging 381 pounds or more on the new basis. Of the bulls mated with cows averaging 347 to 381 pounds only 52 per cent increased production. In the group of cows averaging 312 to 347 pounds 57 per cent of the bulls increased, while 66 per cent increased when mated with cows averaging from 277 to 312 pounds. Seventy-five per cent increased in the group of 243- to 377-pound cows and all 9 of the bulls increased in the 208- to 243-pound class of cows.

We might conclude that the safe thing to do would be to buy from breeders represented in the more successful groups and just forget about the rest. Such is not possible. Unfortunately the breeders do not continue in one class. A great breeding bull is obtained by good fortune and the herd becomes well-recognized as a high-producing herd. Then when you or I go to such a herd to select a herd sire the old bull responsible for the progress is gone and a new herd bull is in service. Too often the new herd sire later proves to be a failure, yet he may be the sire of the bull we selected to head our herd. By the time we know the facts about our bull's sire we already have two crops of calves in our herd.

A more recent analysis of 113 herds in 30 states shows similar results. All but five of the herds had averaged above 300 pounds of fat per cow for about five years, more than a third of them averaged 400 pounds of fat or above. Yet of the 232 bulls that had been proved in these herds 40 per cent decreased production. How then, with such a large percentage of bulls that decreased production, could the high level of production be maintained in these herds over a five-year period. There is only one answer, culling. Too many cows were raised to get one good one.

That is a problem which is not fully appreciated. With a high-producing cow the returns over feed cost during the first lactation are just about equal to the cost of raising a heifer to two years of age. The true returns over feed cost, therefore, do not begin until the second lactation. Now suppose that in the case of an unsatisfactory bull two out of each five of his daughters must be culled because of low production after the end of the first lactation. Not only is the average production of all five low,

but in addition the two that are left after culling must produce several additional lactations before the owner can break even on the cost of raising all five heifers. Thus the loss resulting from a poor bull is much greater than indicated by merely lessened average production.

Breeders are sometimes too much inclined to glorify the fact all cows in their herds are less than 5 or 6 years old. There are at least some reasons why this may not be a good thing. From the point of view of commercial production there are represented too many over head years, i. e., cost of raising, and too few dividend years, i. e., lactations after raising costs have been paid. A two-year-old heifer that makes 225 pounds of fat is equivalent to a 300-pound mature cow from the standpoint of a breeding animal, but from the production viewpoint the farmer must get his profits from the 225 pounds of fat regardless of whether it comes from a promising two-year-old or a low-producing mature cow.

Some people may remind us that surveys have always shown that registered bulls have, on the average, increased production. That is true. In fact, 55 per cent and 60 per cent of the bulls increased production of the better Holstein herds in the two studies previously mentioned. You and I, however, cannot build a breeding program with but a little more than fifty-fifty break. We are not so much interested in what bulls do "on the average" as we are in what our particular bull's daughters will do in comparison with their dams, after we have spent two years' time and money in raising them. We need a more accurate method of predicting the results. In order to go very far in a long-time breeding program we must not only have some system whereby we can select a bull that will increase production, but be able to do that several consecutive times. When three successful breeding bulls are used in succession the final results are almost beyond our fondest hopes.

It is apparent that the fault in the past program has not been in the system of breeding, but rather the great hazard of predicting each bull's influence on the herd in which he is used. Many of our leading breeders have worked out elaborate line-breeding programs but they have failed just as often, or perhaps more often, than the rest of us. Why worry about line breeding, inbreeding, outcrossing, nicking, etc., when we have been able to select a good breeding bull only a little over half the time.

Is there any solution to the problem; if so, what is it? The only sure answer is, proved sires.

In the past the most important measure of value in an unproven

bull was the size of the dam's record. Facts support the statement that bull selection based on the dam's record has not proved successful in years past. What, then, shall we look for in a pedigree if we must use an untried bull? First, and foremost, the sire should be a good proven sire. If that is true, we are reasonably certain that the inheritance coming from the top half of the pedigree will be satisfactory. The information on the ancestors back of our bull's sire is of relatively little importance provided the sire is proved to transmit production to his daughters. The proof is better than any prediction back of him.

The second consideration in the selection of an untried sire is that his dam shall have a reasonably good record to indicate she carries the inheritance for high production. This side of the pedigree is less certain as we do not know whether or not the dam will transmit her production to her son, due to mixed inheritance. To safeguard against mixed inheritance the third requirement should be that the dam's sire be a proved bull. Her dam should have a record and in turn be by a proved bull.

By having the top half of the pedigree practically certain and by having the bottom half composed of consecutive generations of good producing females and good proved bulls the risk in selecting the untried bull will be materially reduced. Breeders have been too much inclined to glorify the record and appearence of the dam. We must change our viewpoint or continue to make facts in an attempt to forecast the fifty-fifty guesses. The value of a pedigree is to furnish essential facts in an attempt to forecast the transmitting ability of the animal. Padding pedigrees with far-fetched statements never helped a bull's inheritance. We laugh at fortune tellers, yet some pedigrees, if taken at face value, are not much better in predicting the future.

Shooting Farm Layout

Condensed from Farm Journal

W. F. Schuyler

THREE miles in the air, hidden from your eye, an airplane zooms along at 80 miles an hour. The pilot, clothed in fur and wool, breathes oxygen from a tank to keep from getting sluggish. He must be alert, for the speed and altitude of his plane must not vary.

In front of the pilot is an accurate map of the country over which he is flying. On the map are parallel lines in red ink drawn equal distances apart. Here and there on the map are landmark symbols. The pilot looks first at one of these symbols on the map, then through a window beneath him, to discover the landmark on the earth below. In this way he gets his bearings, follows that red line to the end, then turns and follows the next line back, much as you would in cultivating corn with a tractor.

In the cabin behind the pilot is another man with a huge camera. His camera looks directly down through a hole in the floor of the cabin. At a signal from the pilot he begins taking pictures. He snaps one and turns the film, takes another and turns the film. There is not a square inch of the earth's surface beneath that escapes his lens.

These men are making aerial maps of farm land—farm layouts the farm management experts might call them. By the end of the year close to a half million square miles of farm land will have had their pictures taken. That's almost one-third of all the farm land in the United States.

Principal user of these maps is the A.A.A., which finds them an improved method of determining what farmers are doing in the agricultural conservation program. Airplane cameramen, employed by private aerial survey companies, will take pictures of 350,000 square miles of farm land in 34 states, for the A.A.A. this year.

From each snapshot made by the winged camera, a print is made. This print is an aerial map. On the map are all ground features, such as buildings, roads, fences, ditches, woodlots, hedgerows, etc. Terraces and strip cropping show clearly on the maps. Accurate measurement of

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fields can be made from the maps because the maps are made according to scale. When all the individual prints are brought together, the result is one big farm map of the entire area.

From these picture maps, it is possible for experienced checkers to determine quickly the area of corn, or cotton, or grass in each field. There is no need to remeasure each year, so long as the farmer does not change any of his natural or permanent boundaries. Changes of that sort are quickly apparent to the men checking the maps.

Contact prints made from the films are about nine inches square. Each print shows about nine square miles of land. Enlargements are made from the films, and from these enlarged picture maps, accurate land measurements are made by means of an instrument called a planimeter.

Thanks to the aerial map and the planimeter, quite a few farmers have learned the real truth about how much land they own. One actual case I learned about in Washington, from the agricultural conservation folks, has to do with a Louisiana farmer. He protested that the map made from one of the aerial shots was wrong, because it showed he had only 151.3 acres of land.

"I've got a quarter section, and that's 160 acres," he vowed. The land was measured with surveyor's instruments and the answer was exactly the same as the figure arrived at from measurements on the aerial map with the planimeter. Still protesting, the farmer looked over his deed, came back rather sheepishly and said it read: "151 acres more or less." He had been paying taxes on 160 acres for several years.

While this aerial mapping is a new thing to most farmers, it is not a new venture for the A.A.A. Several counties were mapped experimentally in 1934, and some more in 1935. The maps were found to speed up accurate measurement of land owned by farmers taking part in the federal program. The A.A.A. found the new method not only quicker, but cheaper and more accurate than anything they had tried.

The aerial picture map is used by many farmers in place of a sketch of farm layout drawn to scale. Such a layout map is an excellent aid in planning farm rotations and in rearranging fields for better farm management methods. Some farmers have the maps of their farms in a frame on the wall of the farm office.

Rains Stay Put

Condensed from The Nebraska Farmer

MAN has never been able to make water run uphill, but he is doing a good job in preventing it from running downhill on the Mankato, Kansas, Federal Soil Conservation Project. On this 136,000 acre area of rather hilly land where rains formerly washed the slopes badly, carrying with them valuable top soil, the water runoff has been largely checked by terraces, contour farming, strip cropping, pasture contour furrowing, and other approved cropping practices.

When several hundred farmers met at Mankato to inspect this large federal project, the time was opportune to see the work under a practical test. Two days before, heavy rains had fallen and on the terraced and contoured farms where visits were made the water was practically all impounded behind terraces and contour furrows in fields and pastures. The draws through such fields had carried but little runoff water while on adjoining farms not so handled, and particularly in cornfields listed up and down the hills, the water had flowed freely through the draws with considerable top soil from the slopes.

Three hundred and 38 farmers are co-operating on the Mankato project with 71,166 acres of their land under agreement. Two hundred and sixteen of these farmers are using 1,145 miles of terraces protecting 24,638 acres. Acres terraced and contour-farmed total 19,710, while 913 acres are being contour farmed without terracing. The men in charge of the Mankato project think very highly of contour farming, but they contend that terraces are also necessary, especialy on the steeper slopes and to serve as guides for contour farming. Strip cropping is also necessary for supplemental protection on sharp slopes between terraces.

In the past two years on the Mankato project, a great deal of work has been done in pasture contour furrowing, 3,542 acres being protected by this method which consists of plowing a furrow on the contour in pastures with a specially built machine which leaves the furrow slice grass-side up on the low side. The machine has recently been improved to make the plow reversible and thus the land can be furrowed in both directions. By laying the furrow slice on the low

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side, the water holding capacity is increased. Best results have been obtained from furrows about 1 rod apart. The furrow grasses over in a couple of years and meanwhile grass for 8 or 10 feet on each side of the furrow is greatly stimulated in growth, due to the increased moisture.

Farther west in Kansas, at the Fort Hays Experiment Station, contour farming and the use of the damming lister are looked upon as sure-fire moisture conservation practices. L. C. Aicher, superintendent of the Hays station, and his associates, have pioneered in building basin lister attachments and are staunch advocates of such equipment for small grains and sorghums, either on summer fallow or cropped land.

Experimental work at Hays has shown consistently the value of summer-fallowing for wheat and this year in early June summer-fallowed wheat there gave promise of a 20 to 25 bushel yield while wheat on continuously cropped land was largely a failure. During the past 29 years at the Hays station only 7 winter wheat yields on fallowed land of less than 20 bushels to the acre were obtained, and of these 7 only 3 were less than 10 bushels. Nineteen years of continuous cropping of wheat on early plowed and early listed land gave average yields of 17.1 bushels per acre on the early plowing and 18.9 bushels on early listed.

Mr. Aicher is convinced that the damming lister, plus contour farming will conserve nearly all the water that falls and that this will greatly reduce the risk in wheat farming in western Kansas.

Extensive soil moisture tests at the Hays station have shown conclusively the relationship between the soil moisture content at time of seeding and the acre yields of wheat. For the 26-year period, 1910 to 1936, plots which were dry at seeding time averaged 4.9 bushels to the acre. Plots wet 1 foot deep at seeding time averaged 8.7 bushels. Plots wet 2 feet deep averaged 15.2 bushels, while plots wet 3 feet deep or more averaged 26.5 bushels.

When Physics Goes Farming

Condensed from The Atlantic Monthly

George R. Harrison

Director of the Research Laboratory, Massachusetts Institute of Technology

A farm is a factory where the energy of light is used to make cheap simple molecules into valuable complex molecules. In another sense it is a packaging establishment where energy from sunlight is bottled up in the molecules of matter and held for future use. Farming is thus both a chemical and a physical process. That chemists have had much to contribute to the development of new agricultural methods is well recognized; that farmers need physicists to aid them is equally true but not so obvious.

Agriculture, the world's greatest industry, is still in the era of its development which corresponds to that of the sailing ship in transoceanic commerce. The continued existence of two billion humans depends on what the land produces, and two out of every three people draw their livelihood from farms, but farming still remains in most instances a discouraging process of slim and uncertain profit.

The cheapest way often is not the most economical. The winds blow free across the seas, but it is cheaper to spend $10,000 on oil to send a liner from New York to Liverpool than it is to fit the same vessel out with $2000 worth of sails and accept the freedom of the winds. The original farmer merely picked his crops where he found them growing wild, as the first boatman floated on his log wherever the current carried it. Then the farmer scratched his land and sowed his seed, and the boatman learned to paddle with a stick. When the boatman invented a sail, the farmer matched him with an irrigation ditch. Then the sailor called in the scientist to help him, or rather found the apparatus produced by science forced upon him by economic necessity. The farmer with ambition feels that he too has become very scientific during the last thirty years. His experiments with scientific farming are as yet, however, but as a chugging paddle-wheeled ferry compared to the steamboat whose smoke is now becoming discernible.

Plant growth has four basic needs: light, air, water, and a comparatively small supply of

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such chemical elements as magnesium, phosphorus, sulphur, silicon, and others. The plant takes from the air the materials which it needs most to build its structure. Since the chemical reactions within its cells must take place in solution, water is stored in them and the turgidity of these cells gives rigidity to the plant structure. Light furnishes the energy with which the plant abstracts carbon atoms from carbon dioxide molecules taken from the air. With these carbon atoms and hydrogen and oxygen atoms from water and air, the plant builds starches and sugars which furnish most of the chemical energy used by man. In addition to its edible components, the plant also synthesizes cellulose materials which man burns, saws, spins, and otherwise shapes to his advantage.

Once the proper fertilizing ingredients have been added to the soil (if not already present) the plant carries out these chemical operations most effectively, and the chemist comes into the picture largely in connection with utilization of the crop. The great primary problems of farming, apart from fertility, involve investigating and controlling temperature, light intensity, soil mechanics, and water application and disposal, all of which are problems of physics and its derivative sciences.

The full time of a few physicists is now being given to research designed to improve agriculture. The agricultural income of the United States was about $5,000,000,000 in 1935. With less land in use than at present, but with the use of improved methods, this income could be increased manyfold. Increasing agricultural efficiency is not essentially different from designing more efficient light sources or learning how to telephone greater distances—it merely requires co-operative research in a greater variety of sciences.

If fresh ripe cherries are desired in Maine in February, there are three ways to provide them. The fruit could be brought at high speed from Australia or the Argentine or anywhere else where cherries are ripe in February; improvements in transportation are needed to make such hauling profitable. Or the cherries could be raised wherever cherries will grow, picked whenever they ripen, and then kept until February by some method which would preserve them unchanged for at least six months—a cherry which cannot be distinguished from a fresh cherry *is* a fresh cherry to its consumer. Or the cherries could be raised in Maine in February by treating the cherry trees in some way that they would feel June weather about them. All three of these methods are at present in promising stages of development, and

the principal requisite needed to make them economically practicable is cheaper energy. In fact, if electrical energy could be delivered to farms at the rate which it is now sold wholesale to industrialists near large power-producing plants, a rate less than one tenth what the average farmer has to pay, the second and third methods would now be feasible and profitable. That rural power could be made cheaper by proper organization is emphasized by the fact that nine tenths of the average electric power bill is paid, not for power, but for the privilege of turning it on or off at any time.

The United States is woefully behind times in farm electrification even for such obvious things as water pumping, wood sawing, and the thousand other tasks that for years have added to the drudgery of farm life. When a man saws wood by hand, he is earning five cents an hour, which is what it costs on the average to have electricity do the same job. In Switzerland 98 per cent of the farms have electric power, while in Sweden almost half of all farms are so equipped; in this country not more than 4 per cent of farms are wired for electricity, in spite of the fact that the United States uses four times as much electric power per person as the rest of the world and that its domestic and industrial power consumption is climbing steadily. On one farm of 600 acres in England only two horses are kept, while over sixty different uses are made of electricity.

The use of artificial light to supplement rather than to supplant sunlight has been found of economic advantage, both to hasten and to retard the maturing of flowers and fruits. The sunlight falling on a square yard of garden surface costs three cents an hour to duplicate electrically, a figure which amounts to over $100 per acre per day. Artificial light may profitably serve to eke out sunlight on dark days and sometimes during the night, but electrical energy cannot compete directly with solar energy until its cost has been greatly decreased.

Light judiciously applied makes flowers and fruits more brilliant and colorful. But lots of light must be used; the five or ten foot-candles of artificial light provided in the average living room is negligible compared to the two to ten thousand foot-candles a plant gets from the sun out in the open.

Filtered light may be useful, as some plants are injured by the heat content of solar radiation. Only one fifteenth of the energy in the light from the sun is of the proper colors to be used by plants; the remaining 93 per cent serves only for heating air and

soil, and may burn delicate plant tissue.

That all colors of light are not equally effective in promoting plant growth may be inferred from the fact that leaves are bluish green in color. The absorption of light by chlorophyll and by both dead and living plant leaves has been carefully studied with the spectroscope, and red has been found to be the color most vigorously absorbed and utilized.

By growing similar plants under conditions identical except as to illumination, one group of plants being under blue light, another group under red, with others bathed in infrared and ultraviolet respectively, it has been found that such widely differing varieties of plant life as the buckwheat and the green scum which grows in stagnant ponds respond similarly to light stimulation. Biophysicists have found that yellow light from an incandescent lamp will stimulate growth half again as fast as blue light from the same source, while a given amount of yellow energy from a sodium vapor lamp produces more than twice as much growth as the same amount of bluish energy from a mercury arc lamp.

Pure blue light appears to retard plant growth, while ultraviolet light is definitely injurious. On the sides of high mountains, plants which in the valleys below grow luxuriantly are often found flourishing but stunted, an effect attributed to the smaller cell structure promoted by the high intensity of blue and ultraviolet light at high altitudes.

Most florists and hothouse vegetable growers who pride themselves on up-to-the-minute greenhouses are supporting inefficient, expensive, and archaic structures. A greenhouse is supposed to be an illuminated energy trap. Light of most of the wave lengths received from the sun penetrates glass, and once inside the greenhouse it is absorbed by plants and soil. As the temperature within the structure rises above that of the outside air, its inner contents begin to radiate heat, but the heat waves radiated from objects so cool cannot penetrate glass. Since the entrapped radiation cannot escape, it must devote its energies to building up the internal temperature of the greenhouse.

On such valid principles of physics was the greenhouse designed, but all too seldom are these principles followed correctly. There is little point in having glass on the north side of a greenhouse, for the north half of the sky gives only one ninth as much radiant energy as the south half when the sun is shining, and more heat is conducted out through the glass than comes

in. Scientists of the Boyce Thompson Institute have designed a new type of greenhouse which turns out to be cheaper to construct and to operate than the ordinary type, and far more efficient. This greenhouse contains little glass, but what glass there is is so disposed as to catch every possible ray of the sun, and to cut down losses by reflection. One half the roof, both ends, and the back wall of the greenhouse are all of sheet metal stuffed with sawdust for heat insulation. No crack is allowed in the walls, for out of this would escape the heat which is to come not only from the sun, when sunlight is available, but from electrical sources as well.

The Boyce Thompson scientists use electric light to lengthen the growing day of the plants when this is desirable, and so add as much as four hours of extra growth each day. When the temperature falls below the desired value the high-power lamps are automatically turned on and the heat from these keeps the hothouse warm. Even with expensive domestic power, the cost of the four hours' extra light and the entire heating was only thirty-six cents per day for a large greenhouse. In this way June is brought to the plants in January, and flowers, vegetables, and fruits can be raised profitably out of season when they command relatively high prices.

With such extensive precautions against external weather variations it is necessary to provide artificially what before was always present as a gift from nature—gas for the plants to breathe! In one corner of the Boyce Thompson greenhouse a block of solid carbon dioxide (dry ice) was buried in sawdust, to evaporate slowly and furnish the gas which to the plants means fresh air. A tiny fire of any sort, to burn the excess of oxygen given off by the plants while forming the carbon dioxide they need, would do as well and would give additional heat, but would require more attention.

The principal part of any farm is usually considered to be the soil. That soil is not essential is shown by the experiments which have been undertaken by a number of scientists who have sprouted seeds on blankets of moist excelsior or sawdust dipping into trays of chemical-laden water. Twenty-fold increases in yield of various crops from strawberries to hay are reported, and it seems reasonable to expect that much of the vegetable and fruit gardening of the future will be carried out in this way. When soil is depleted and the farmer starts replenishing it with expensive chemicals, he begins to realize that the main contribution of

soil is mechanical; it holds the plant upright in a given spot, keeps it from being blown or washed away, and allows water to seep slowly in thin films to its rootlets. However, the chemicals provided by nature, as well as the sunshine, air, and water, are too valuable to neglect entirely, and field crops in the open will always remain of importance.

At the University of Saskatchewan a single grass plant has been found to grow roots at the rate of more than two miles a day, A two-year-old plant was found to have a total root length of over three hundred miles, though no single rootlet was over seven feet long. The soil must be a sponge through which these roots can penetrate, and should bathe them in the nutrient solutions carried by the soil water.

Ploughing is a problem in mechanics, but ploughs have been designed since the beginning of time by trial and error rather than scientifically. Even the modern tractor drawing a gang of ploughs behind it leaves much to be desired as far as efficiency is concerned. Electric ploughs with motors of 125 horsepower, drawing energy from their own transformers which are fed from 30,000-volt transmission lines, are common in France. In other areas seven ploughs fastened together plough a strip eight feet wide to a depth of eighteen inches, and are able to cover thirty acres in a day when pulled by 200-horsepower motors. The day of the streamlined plough is coming!

The chemistry of soils has many dark corners still to be illuminated. Concentrations of certain elements so small as to be difficult to detect by ordinary analysis appear to be absolutely essential to plant growth. The spectroscope is being increasingly used to detect the extremely small amounts of important elements present in soils. In some regions of the West, vegetation in certain areas is spindly and apparently slowly poisonous to animals which graze on it. Investigation has shown that this land has a deficiency of sulphur and an excess of selenium. Selenium atoms are chemically much like sulphur atoms, and although a plant can tell the difference, it will absorb selenium, which appears almost as good, if it cannot get the sulphur it wants. But the selenium is very harmful to animals. With the usual methods long and tedious analyses are required to measure the sulphur and selenium contents of soils. But since the sulphur and selenium atoms give out very different spectrum lines, the spectroscope can be used quite readily to differentiate these substances.

Each pound of vegetable matter produced by a plant requires

the transpiration on the average of forty gallons of water. The yield of some crops is at certain periods extremely sensitive to water application. A variation of two inches in the July rainfall in Ohio is said to cause a variation of $13,000,000 in the value of the corn crop in that state alone.

A century from now a farmer who relies on rain to provide the water for his crops will probably be considered as old-fashioned as we consider the primitive man who harvested his crops wherever he found them in the wild. Rain is so likely to fall when it is not wanted, and not to fall when it is wanted. But floods and drouths are disagreeable only when kept apart; mix a good fat flood with a long shriveling drouth in the proper proportions, and excellent farming conditions result. Storage facilities are all that are required to do this. One of the things man is slowly learning in his gradual climb toward wisdom is that nature need not be accepted as she is at the moment, but can be smoothed out over a period of time and over an area of space, to make the ups and downs of life less severe.

The weather is a field of human interest for which physics must take full responsibility. Whether it rains or shines or snows depends on the physics of the atmosphere.

One new development which shows great promise is the polar-front theory, lately incorporated by the United States Weather Bureau into its official methods of prognostication. This theory, which originated with one of a famous family of weather physicists, Professor J. Bjerknes, of Norway, is proving a powerful new tool in weather predicting. Norwegians seem to excel in the study of weather, perhaps because they live where so much of it originates. Much intensive research is going on in the science of meteorology, and it is quite reasonable to expect that before many more years have elapsed far more precise and accurate short-range forecasting will be possible.

In the midst of a host of pseudo-scientific methods of long-range forecasting, which inevitably arise in connection with so important a subject as the weather, there are a few legitimate methods which are being developed as a result of real research. Dr. Charles G. Abbot, of the Smithsonian Institution has for years been measuring the amount of heat received by the earth from the sun. Three Smithsonian stations in three of the most desert regions of the earth are recording the sun's radiation daily. In almost treeless and waterless wastes, high up on mountain peaks, conscientious observers in Chile, in South

Africa, and in western America have been taking records for many years. Although the heat received from the sun varies by only about one per cent, Abbot finds correlations between changes in solar radiation and temperatures at widely separated stations over the earth. By going back through his records, and by studying the records of earthly weather as recorded in the growth rings of trees which have been followed into the past for over two thousand years, together with other phenomena, Abbot has found what appear to be recurrent cycles in the weather which, if real, should be of great value in predicting long-range trends in the succession of years fat and lean. Such long-range predictions may in the end turn out to be easier to make than detailed predictions for two weeks in advance, and certainly they will be far more important.

According to the estimates of government entomologists, insects each year cause a loss of nearly two billion dollars in the United States, a sum equivalent to the earnings of over a million men. Light, sound, and electricity are all being used to supplement chemical dusts and sprays in fighting insects on a physical basis. A high-power incandescent lamp suspended a few inches above a tray filled with kerosene-covered water in the centre of a sixty-acre field resulted in the capture of about twenty gallons of insects in the first four nights of operation, after which the number of insects caught gradually decreased as the supply gave out. The rancher who used the method claimed that the light protected his beans, corn, and tomatoes, and entirely eliminated the need of sprays and poisons. Corn protected in this way was found free from worms. Ten cents per acre per night spent for electric light decreased the number of insect-damaged tomatoes from nearly half the crop to practically none; in another instance $300 worth of electricity produced light which increased the value of the tomato crop by $2000. A difficulty with this system for general application is that some injurious insects are not attracted by light, while others which are beneficial and necessary may be so attracted. It may be possible in the future to raise such worthy creatures artificially in a form which is not attracted by light, and "Smith's Non-Phototropic Ladybugs" may be a subject of future advertisements.

Insects can be killed by high-speed electrons shot from an evacuated high-voltage tube of a type designed by Lenard many years ago for experimental purposes of a different nature. This has been termed a death ray, but such methods would be expensive

and limited in application. A more effective death ray has been found to be the simple sound wave given out by a large electrical transformer near Boston. The hum of this giant carried far through the night, and was apparently mistaken by male mosquites for the mating call of a particularly alluring female. Whatever the cause, large numbers of male mosquitoes appeared, only to be electrocuted and cast dead at the base of their electromagnetic Lorelei.

An electric fan sucking air into a bag placed under an electric lamp has been used to gather in a single night ten pounds of gnats, running about a million to the pound. A little bit of this sort of thing would go a long way in gnat circles.

The physicist is able to aid the plant physiologist and the geneticist in rapid development of new species. Mutations, those startling dissimilarities of offspring to parent, can apparently be greatly increased in number by bombarding seeds with X-rays or high-speed electrons. It is thought that the electrons set free inside the seeds by the colliding rays bombard the genes which control the characteristics of the plant-to-be. With mutations greatly increased in number, artificial selection can rapidly be applied to breed new types of useful crops.

Bulb growers on Long Island have already adopted new varieties of double gladioli and double narcissi which have been produced by exposing bulbs to X-rays. A scientist of the General Electric Company has suggested that orange trees which would resist the cold might be developed in this way. Many freak varieties of plant have been produced—most of them valueless from an economic standpoint, to be sure, but all of importance in studying the processes of plant reproduction and variation. Many plants springing from seeds which have been subjected to the rays are found to be stunted, while in some the life processes have been greatly speeded up. Grapefruit trees two inches high, for example, have burst into blossom at the tender age of five weeks.

It may seem strange that farmers can be taught anything new about hay farming after ten thousand years, but new methods of artificial curing now being undertaken show remarkable possibilities.

Hay is not merely dried grass; it is cured grass — by which is meant that certain changes produced by physical conditions of heat, humidity, pressure, and air flow other than mere loss of water occur in the plant material. Almost two-thirds of the total grass weight must be evaporated as water vapor. Haying has always

depended on the weather, but the age-old ready-made methods of cutting grass and leaving it to cure in the field are gradually retreating before the application of more controllable physical processes. Three British experimenters have found that they could greatly expedite and cheapen haymaking, and get a superior product, by piling the wet and new-cut grass around a wooden duct, in such a way that hot air could be blown through the pile. Using a five-horse-power motor they found it possible to cure a forty-ton rick of hay in thirty hours during typical English days of rain and fog. The hay commanded a premium in the market, as cattle were found to relish it better than ordinary hay.

Fan-made hay was found two-thirds as expensive to prepare as sun-made hay. The chief saving came from less handling of the hay, and smaller loss from weather. By installing thermometers in various parts of a large rick, the temperature changes, which are influenced somewhat by fermentation and curing of the hay itself, could be followed, and the experimenters were able to produce green- or brown-colored hay at will.

The silo is a piece of physical apparatus which produces, by the chemical reactions produced by fermentation, a highly nutritious animal food which will last all winter. Now comes the electric silo, with current of electricity passed through the silage as the chopped green material is fed in by air blowers or belt conveyers. Up to thirty amperes of current are passed through the material, heating it and hastening fermentation. A silo described by R. B. Matthews holds 3000 cubic feet of food and requires not over 480 kilowatt hours for processing. The silage produced is of an improved character, for the lactic acid bacteria which transform the fodder into silage, much as cabbage is transformed into sauerkraut, are given an advantage over the heat-dreading deleterious bacteria which impede the preservation process.

The methods of science go to the root of farm problems; the methods of politics and economics, while necessary for temporary adjustments, can never do more than re-arrange the surface aspect of things. One single basic scientific discovery can make all of the economic solutions to the plight of the farmer unnecessary. The man with the hoe should be non-existent a hundred years from now.

The Palomino

Condensed from Western Livestock Journal

Marco Hellman

MUCH has been said and written about the California stock horse and the growing tendency to provide classes for him in Western horse shows has had a marked effect in the establishment of a definite type on which to consider his case.

The Palomino (Spanish for cream) refers to color and has only recently become established as a breed. It may be said that few breeds of horses have ever had a more definite basis or a more thoroughly established type to start with and few of them were more deserving of a stud book of their own than is the Palomino.

California, and particularly Southern California, had been in its earlier history a famous saddle horse country, the home of the Spanish "Dons," whose proudest possession was their best "caballo," which may have been imported at the cost of immense trouble and expense from Andalusia, more often the result of careful home breeding of stock from the same source, or as the case might be, with more or less admixture of the wild stock of the "range" which was not native to this country, but had developed from the horses escaping from the early Spanish padres and conquistadores or turned loose when the latter returned to Spain.

Then, as now, the first requirement of a showy stock horse was style and finish. Substance and magnificence were also a necessity and, of course, speed, agility, endurance and courage. A good brain was also needed because this was a horse with work of an intricate nature to do and an agile brain is the source of operation of quick acting muscles and the ability to assimilate the intensive training necessary to his education and perfection.

Color was not a fixed factor though undoubtedly there was a marked softness for the pinto (paint) and either the red or blue roan. These were the favorites though quite common colors were black, bay, chestnut, white, and buckskin (dun, with black tail, mane, feet and lower legs, and probably a dark stripe the length of his backbone and possibly faint fan-like stripes from

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the withers down the shoulders. All of these markings tracing as some believe to the zebra). The pinto might be any color and white—white and bay, white and black, white and chestnut, white and dun, or even white and roan. The Palomino ranged through slight variations of shade between cream and dun.

Although the Palomino(cream) was in disrepute during earlier Spanish days on account of his supposed lack of stamina, he was probably unjustly accused on this score and today this is the most popular color whose representatives probably carry more of the blood and more nearly reproduce the original California type of stock horse than any other.

Long continued and scientific breeding experiments have been carried on in California and Oregon by a number of wealthy horsemen to establish the Palomino color and the stock horse type. This seems to be simple but as a matter of fact has been found a very difficult proceeding for there never has been a breed in which the Palomino or cream color was more than incidental. "Buckskins" or "duns" were not uncommon amongst the wild horses of the plains and occasionally a white stallion will show a strong predilection towards getting colts of this color.

With this as a basis of operation several bands of Palominos are now owned in which the tendency towards other colors has been almost eliminated and it is for this reason that a stud book has been established to perpetuate this particular color of the stock horse breed.

The good California stock horse of today carries a goodly percentage of Thoroughbred blood combined with a heritage of Arabian and Barb that came to him from his Spanish day ancestors. He is a good horse of sterling qualities and much better bred than ever his best friends would believe possible.

The stock horse has a style and quality of his own and there is no pleasure horse that is his equal for safety, weight-carrying or dependability. He knows how to take care of himself and his rider and is the ideal of handiness, hardiness and adaptability.

The old time Californian trained his horse's mane to the near or left side and this maintains with real stock horses to the present day, the reason being that the riata, or rope, is swung usually with the right hand and coiled and hung at the right side of the horn or pommel. Also the mane when on the near side could be used to advantage in mounting. In connection with the handling of the rope it might be mentioned that the head of the stock horse is carried low so as not to interfere with the free use of the rope.

Hence, the short, sturdy neck.

The stock horse type is as distinct and definite as any known. Strong, sturdy enough to carry weight, with plenty of bone, well strung up muscles, a good back, a big front, and sloping shoulders that he may be sure-footed. The type was the result of intensive selective breeding under the most favorable of conditions involving his necessity for daily use, in large numbers, for a definite purpose, extending over a period of almost two hundred years, and the result combines every good quality that a horse can have except extreme speed. He has been an indispensable adjunct to the cattle business from its beginning and will so continue until the end.

Swine Erysipelas

Condensed from American Hampshire Herdsman

Robert Graham

Chief in Animal Pathology and Hygiene

G. L. Dunlap

Associate in Animal Pathology and Hygiene

SWINE erysipelas is caused by a small, slender, rod-shaped micro-organism (Erysipelothrix rhusiopathiae). In the acute type of the disease the micro-organisms are found in the blood and all body tissues. In the chronic type the micro-organisms become localized in the joints, skin, heart valves, gall bladder, and tonsils.

Laboratory tests show that heating to 160° F. kills the swine-erysipelas organism in 5 minutes. The following disinfectants are effective in 5 to 15 minutes when applied directly on the organism: bichlorid of mercury in a dilution of 1 to 1,000; 5-percent phenol solution; 3.5 percent compound cresol solution; 2 - percent formalin; 1-percent lye solution. The nature of the material in which the organisms are present greatly influences the length of time necessary to kill them.

Infection usually occurs thru the intestinal canal. Feed and drinking water contaminated thru contact with offal of diseased animals are the usual carriers of the infective agent. Feeding infected

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pork trimmings in kitchen slop to susceptible animals may cause new infection. Injuries to the intestinal lining, such as those produced by the thorny - headed worm, facilitate infection. Skin wounds also serve as a portal of entry.

On a farm where there has been a serious outbreak of swine erysipelas, infection tends to recur in succeeding crops of pigs, either thru contact with chronically infected animals that appear healthy or thru exposure to contaminated houses, lots, and pastures.

Only slight changes in the internal organs of animals which succumbed to the acute form of swine erysipelas are apparent at postmortem examination. The lining of the stomach, particularly at the intestinal outlet, shows an inflammatory swelling, reddening and numerous small hemorrhages. The surface is covered with a sticky, glassy mucous. The visceral and body lymph glands show varying degrees of swelling, edema, and congestion. The spleen is usually swollen and the pulp very dark in color. Small hemorrhagic lesions also occur on and under the lining membrane of the heart chambers. In the advanced stages of the acute disease, as well as following death, the skin over the abdomen may show red, purplish blotches. Some animals recovering from the acute type may show sloughing of the skin over the back and shoulders.

In the chronic form cauliflower-like growths may develop on the heart valves. These growths sometimes constrict the valve opening. These lesions may also occur on the walls of the heart. The internal organs manifest the secondary changes which are usually produced by valvular lesions. These changes include an increased amount of fluid in the thoracic and abdominal cavities, and passive congestion of lungs, liver, and spleen. Small fragments of the cauliflower - like growths break away and are carried in the circulaton to remote parts of the body, where they plug the small arteries. The small, light-colored nodules at the border of the spleen are the result of the plugging of small arteries by fragments from the heart - valve lesions.

Lesions of the joints are accompanied by definite bone changes which are easily visible at autopsy. The ends of the long bones and the small bones of the knee, hock, and pastern joints show excessive bony growth. The surfaces of the joints may be eroded and there may be an increased amount of cloudy, flocculent joint fluid.

When the disease occurs in the form of "diamond-skin," a mild inflammation of the skin, sharply

circumscribed, round, quadrangular, or rhomboidal spots develop, especially on the skin of the chest, back, thighs, and neck. As a rule the spots or plaques are small, but they coalesce and form areas as large as the palm of the hand. The most satisfactory bacterial antigen for the rapid plate agglutination test for swine erysipelas, as applied at the Laboratory of Animal Pathology and Hygiene, has been secured from Schoening of the United States Bureau of Animal Husbandry.

Inoculation of susceptible laboratory animals is often resorted to in order to arrive at a positive diagnosis. Pigeons and mice are the experimental animals most commonly used for this purpose.

The acute form of swine erysipelas may be confused with hog cholera, hemorrhage septicemia, or the acute stage of necrotic enteritis. The chronic form may be confused with malnutrition rickets, chronic porcine infectious abortion (Brucellosis in swine or Traum's disease of the bones and joints), as well as streptococcic infections.

Swine erysipelas has been encountered in lambs, ducks, and turkeys, as well as in field mice. Pigeons are also susceptible. Infected animals and animals that have apparently recovered from the disease may serve as carriers of the infection, and an outbreak in swine may spread to lambs, ducks, and turkeys on the same farm or from these animals to swine. Furthermore, certain precautions should be taken by anyone who handles infected animals, for germs of swine erysipelas can cause a local infection on human hands. In the treatment of infected animals, as well as in handling the carcasses of animals that have died of the disease, gloves should be used to avoid human infection.

Animals infected with swine erysipelas should be isolated and the herd inspected daily for further evidence of the disease.

Herds showing suspicious clinical symptoms and gross autopsy lesions of acute swine erysipelas may be inoculated with specific anti-serum pending a definite laboratory diganosis. Marked improvement has been noted in 48 hours following the administration of anti-swine-erysipelas serum in acutely infected herds. For chronically infected swine, inoculation with anti-swine-erysipelas serum has proved of little value.

When diagnosis is doubtful and the disease may be either hog cholera or swine erpsipelas, experience to date suggests that it is always advisable to use anti-hog-cholera serum and virus to reduce the possibility of losses from hog cholera.

Healthy susceptible swine

should be kept away from contaminated houses, lots, and pastures. Carcasses of diseased swine should be deeply buried or burned. Offal from slaughter houses and pork trimmings from kitchens should not be fed to pigs.

Contaminated houses should be thoroughly cleaned by being scraped, brushed, or swept, and should then be scrubbed with hot lye water, 1 pound of lye to 30 gallons of water. After the lye solution has been allowed to dry two or three days, the house should be sprayed with a 3-percent compound cresol solution (U.S.P.) or its germicidal equivalent. Lots and pastures used by swine infected with erysipelas should not be used again for hogs, lambs, ducks, or turkeys for at least year. All manure from contaminated houses should be spread thinly on ground not used for these susceptible animals.

When purchasing replacement stock, extreme precaution should be exercised. Swine erysipelas is commonly introduced on a farm by the purchase of chronically infected animals that appear healthy. In fact the disease was introduced on many Illinois farms in 1936 thru the purchase of diseased feeder pigs from drouth-stricken areas.

Preventive measures are important as a means of avoiding future losses. Dirty hog houses and contaminated lots perpetuate infection.

We Seem to Love Poisons

Condensed from Forest Leaves

H. Gleason Mattoon
President of The Pennsylvania Forestry Association

CONTROL of tree pests is an ever-increasing problem for the orchardist, the forester and the owner of shade and ornamental trees. The point has been reached where it seems necessary to put millions of gallons of poison on everything each year if we are to preserve our property.

The annual loss to forests caused by insects is estimated at over $175,000,000. While no figures appear to be available as to the cost to orchardists, the amount is undoubtedly more than $100,000,000. If all crops are included, over $2,000,000,000 a year is devoured by bugs, $40 for each voter in the country.

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A list of the more destructive insects would contain many exotic ones that in one way or another have become established here. In the orchard and woodland the codling moth, the gipsy moth, the brown-tail moth, oyster shell scale, San Jose scale, golden oak scale, European elm soft scale, the leopard moth, the satin moth, the Japanese beetle, the European pine shoot moth and other immigrants are most destructive. The many methods of intercourse between countries have made effective quarantine against foreign pests well nigh impossible. We should expect that others will find their way here despite our efforts and should direct our energies to comprehending the relationships that keep them under control in their native habitat.

It is quite true that we cannot stop spraying or our vegetation will be devoured. On the other hand, we should get over the belief that pouring out poisons is the only way in which insects may be controlled. Nature in her intricacy maintains a delicate and complicated system of checks and balances about which man knows little at present. These checks and cross-checks are innumerable. An insect to destroy a bird. A bird to eat an insect. An insect to eat a fungus. Fungi to kill both birds and insects, and animals to devour birds, fungi and insects.

The balance is never constant. First one and then another has the ascendency, but if nature were left alone, few severe outbreaks would occur. Of course, this is impossible, for civilization has upset nature's balances too greatly.

The white - marked tussock moth which destroys the leaves of shade and street trees in many cities is a typical example. No less than twenty-one parasitic insects exist at the expense of this moth. In addition, fourteen hyper-parasites, insects which destroy the parasites, have been found, while four parasites of the hyper-parasites are known. It is quite possible that there are also parasites of the parasites of the hyper - parasites. This complicated realtionship is indicative of the intricacy of nature.

But with all, the white-marked tussock moth does much damage because man has interfered with another of its relationships. Cuckoos, tanagers and other birds, which were plentiful in the cities in days gone by, relish the caterpillars of this moth. But the English sparrow, a European introduction, and other influences of civilization have driven the native birds from the cities. Not having the control formerly exercised by birds, the tussock moth is more numerous than nature

intended, hence we have to buy poisons and spray machines and discolor the foliage so that it will not be devoured.

Research is being done to understand these balances of nature, but more scientists are needed who can devote their entire time to this complicated problem. Breeding stations should be set up where warblers, thrashers, tanagers, vireos, cuckoos, orioles, jays, bluebirds, robins, chickadees, woodpeckers and others may be reared and released. A pair of warblers will consume several thousand scale insects in one day. Nuthatches and vireos will do equally well. A pair of orioles or cuckoos will devour as many canker worms as are killed by 100 gallons of poison spray.

It is time the scientist ceased his search for more and deadlier poisons and directed his energies to a more enlightened understanding of the innumerable ramifications of nature's balances. When we comprehend more clearly this complicated interrelationship, a more intelligent method of controlling insect outbreaks may be devised. A start has been made in combating the Japanese beetle. The parasites which were first introduced from Japan and are now reared in this country are unquestionably a more effective control than the tons of arsenate of lead that have been put on trees.

Every time a spray is applied to kill scale insects or plant lice, numerous ladybird beetles and ant lions, the greatest enemies of these injurious insects, are killed. If man, with his inefficient methods of control is going to kill the parasite and predator, the natural enemies of these pests, he must rear others to take their place.

I can visualize the time when we will order so many millions of Ichneumon flies rather than so many tons of poison. A thousand gross of lady-bird beetles are much easier to throw into a tree to control aphids and scale insects than spraying with oil or nicotine.

The rearing of parasites and predatory insects, once their relationship to injurious insects, hyper-parasites and other forms of life is known, should be a definite project. The day may come when our pet shops and agricultural supply houses will carry stocks of praying mantids, solitary wasps, syrphid flies, ant lions, Ichneumon flies, ground beetles and other beneficial insects.

Education and investigation should go hand in hand. The wonder of it is that man, who is dependent upon nature for his very existence, seems so anxious to devise artificial means of controlling injurious insects instead of understanding nature and her ways.

Sorghums

Condensed from Successful Farming

John A. Bird

Kansas State College, Manhattan, Kansas

SORGHUMS have courage. At least they always strike me as courageous, seeing them still green, with leaves rolled against the blazing sun, patiently hanging on and waiting for rain, while the rest of the broad landscape curls up, seared brown by drought and the blasting breath of the midsummer plains' winds.

Having good sorghums means much to the plains country. Steadily they are moving east and north, as more and more farmers along the border of the semi-arid region are finding that year in and year out sorghums will make a crop when corn just can't take it.

Drought resistance is only one item in their list of accomplishments. They have also proved themselves extremely pliable in the hands of the plant-breeders, and, as a result, a farmer can choose that special type of sorghum that best fits his general farming conditions. He can select a forage type, or a grain type, a dual - purpose, grain-and-forage variety, or a stubby, heavy-headed combine variety that can be planted and harvested just like wheat, with wheat machinery.

And now the plant-breeders and entomologists are going a step farther with the sorghums, adding another valuable gadget to this splendid line. It's chinch-bug resistance!

After 15 years of work on the problem of bolstering up sorghums against their potent enemy, the chinch bug, it now appears that farmers in bug-infested areas may not have to wait much longer to get sorghum varieties that will make a fair crop when the ordinary kinds would be riddled.

In fact, I have seen such sorghums, beautiful types of plants, that laugh at the bugs, while some of their non-resistant parents can't stand attack, and die. *But you can't get the seed of any of those new varieties as yet. The plant-breeders have to be sure that they know exactly how a new variety is going to perform before they let it go out of their hands.*

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While the control of insects by development of plants that have inherent resistance is a relatively new field, agronomists and entomologists have noted for some time that there was a difference among the various varieties of sorghums in the extent of the injury they suffered from chinch bugs. The milos, for example, are extremely susceptible, and for that reason they have been confined to the western areas where there are few chinch-bug attacks. Feteritas also have been considered rather susceptible, tho not to the degree of milos. Kafirs and some sorgos, on the other hand, have shown resistance.

The work in studying resistance of sorghums to chinch bugs was started at the Kansas Agricultural Experiment Station. In the course of this work a great deal of information was secured as to the relative resistance of various lines, but it was decided that additional testing should be carried on in a place where chinch bugs were present almost every year, and in plentiful numbers.

The USDA field station at Lawton, Oklahoma, was chosen as the place. Conditions are just right for the pests, and they stand ready, year after year, to give the sorghums a going-over.

It was at Lawton last summer that I saw sorghums that have been developed to possess an amazingly high resistance to attack. The scene was one of contrasts: Here were the non-resistant sorghums, completely withered and destroyed. Pulling back the crumpled yellow sheaths of these dead or dying plants revealed black masses of bugs feasting on the stem.

Standing beside the susceptible sorghums were the new resistant hybrids and selections. they marched, it seemed, around that 20-acre testing plot, standing as sorghums should, straight, leafy, heads up like an army on parade, and green, despite the fact that this was late July and there had been no rain since May. Their symmetrical heads were filled with fast-ripening grain. Nothing but a hailstorm could keep them from making a fair forage and grain crop.

Stooping down, I pulled back several sheaths from their sturdy stalks, and in each case those hordes of black dots tumbled out.

The bugs were there, certainly, but the resistant sorghums didn't seem to mind them. Why weren't they injured? What had been done to them to put *something* into their make-up that let them escape ravages that had killed the ordinary plants?

Ralph O. Snelling of the United States Department of Agriculture,Division of Cereal Crops and Diseases, answered part of my question and admitted that part of it could not be answered

—yet. Snelling has been in charge of the Lawton chinch-bug project since it was established in 1930.

"We go at the problem in two ways," Snelling explained. "First, we find that by *selection* from old standard varieties under chinch-bug conditions, resistant lines can be discovered. In other words, the seed of a standard variety is sent here to be grown. Maybe only a few of the plants will survive or make seed. We take the seeds from survivors and plant them next season, again selecting out the hardy survivors. We have been able by selection of this kind to increase the resistance of a variety to the point where only 28 percent of the selection was killed by bugs, as compared to 59 percent of the original stock.

"However, the second method, *hybridization*, seems to show much more promise. We can cross plants to get resistance in the offspring, and at the same time come closer to what we want in the way of height, type of seed, drought resistance, and all of the other factors."

"Experience has shown that, in general, milos are susceptible, feteritas seem—note that *seem*—medium-susceptible, while most kafirs and sorgos are rather resistant. So we take this resistance where we can find it—in the kafirs, for instance—and breed milos with kafirs in the hope that some of the offspring will be good sorghums of the right type and also have resistance to the chinch bugs.

"We have produced hybrids with more resistance than either parent.

"We came up to a row that took my eye as an ideal combine-type sorghum. It had a short, heavy-set stalk, with the leaves well grouped around the bottom; a long, straight neck, at the top of which rode a symmetrical head, not too compact, and not too loose. The height of the heads in the row was as uniform as a parade of West Pointers. Bright yellow anthers gave promise of a beautiful yellow market grain."

"It would be a pleasure to combine a field of sorghum like that," I remarked. "What is it?"

"A cross between Club Kafir and Day Milo," Snelling replied. "Step up here and I'll show you its parents."

Further up the plots we came to rows of short, runty plants, with the bottom leaves badly fired and the top leaves curled. Many of the heads would make no grain at all, none would make much. It was Day Milo, a good combine sorghum—where there are no chinch bugs.

"The bugs riddle it at Lawton," Snelling commented.

A few rows away stood a row of Club Kafir, the other parent. It was in fine shape, with good

color, fine growth and foliage. The bugs had not bothered it much, it was easy to see. But Club is far too late for this country. Here it was the middle of July and it hadn't started to put out a head yet—but what a splendid parent it made for the Club-Day combination!

"You see," explained Snelling, "we are trying to combine the drought resistance and chinch-bug resistance of Club—a kafir—with the earliness, short stature, and bright yellow seed of Day Milo. It looks as tho this hybrid had what it takes. But we won't put that new plant out to farmers yet—we want to be absolutely sure."

It sounds more simple than it is. You don't just breed a resistant sorghum to a non-resistant and get a perfect new hybrid! It takes plenty of work and tedious hunting and selection.

In the early stages hybrids are tested in progeny rows—that is, all of the progeny from one plant of a cross are grown in one row, and selection of the promising types is begun. After a promising hybrid selection has become reasonably fixed as to type, usually about the sixth generation after the cross, it is moved up to the advanced nursery on a 1/400th-acre plot to get a yield reading. This summer there were 21 varieties and strains in the advanced tests. When it is considered that 2,000 varieties, selections, and crosses are undergoing testing in the nursery, the rigid tests that varieties must pass before they are moved to the advanced plots have more meaning.

The chinch-bug fighters, however, have found out how to take advantage of any latent ability of sorghums to adapt themselves to certain conditions—to fight back at the bugs, as it were—when they are suddenly transplanted from a region that has no chinch bugs to a region, such as Lawton, where they abound. Thus selection has played an important part in developing resistance to a higher degree in a variety than before.

An example of this is Chiltex, a variety from a cross of kafir and feterita made at Chillicothe, Texas, where chinch bugs seldom occur. Seed of this crop was sent to Lawton in 1931, and in 1932 under a heavy infestation, only a few of the plants produced grain. The surviving heads were planted in a row, beside a row of the original seed that had never been subjected to chinch bugs. In 1933, 53 per cent of the plants from introduced seed were killed, while only 23 per cent of the plants in the selected strain were killed. In 1934, the same experiment was repeated under an exceedingly heavy attack of chinch bugs, with the result that 100 per cent of the plants from the introduced seed

were destroyed, while 68 per cent or the plants in the Lawton selection were killed. This year I saw the sixth generation of the more resistant selection of Chiltex growing luxuriantly in the advanced nursery, while nothing but wreckage was left of direct introductions of the same variety.

Insect-resistance work is simply a new attack to reduce the gambles of farming in that wide wheat-sorghum area where there will be plenty of gamble left after we have whipped the bugs.

Experiments Show How Boll Weevil Is Poisoned

Condensed from Farm and Ranch

A. D. Jackson
Texas Experiment Station

THE boll weevil, while crawling normally over cotton plants which have been dusted with calcium arsenate, accumulates small particles of the poison on its mouth parts and is accidentally poisoned. The characteristic habit of the weevil, of bringing the tip of its beak into contact with the surface over which it is moving, and all the while its mandibles are moving rapidly back and forth, results in the almost inevitable accumulation of the poison dust on the beak when the poison has been properly applied, and also accounts for the incidental poisoning which results in fairly good control. The discovery of this peculiar travelling habit of the boll weevil was made by Dr. F. L. Thomas, Chief Entomologist, of the Texas Experiment Station, during the study of the problem.

Until this time, while it was known that proper dusting of cotton plants with calcium arsenate effects considerable control and results in increased yields, it was not known how the poison becomes effective. In fact, it was commonly supposed that the weevil must be eating the poison or drinking it. Experiments were conducted with syrup to induce feeding on the poison, upon the supposition that dew was the drinking supply of the weevil and if poisoned would effect a kill. Mr. Reinhard's observations convinced him that neither of these methods contributed in any mentionable degree to the kill.

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Mr. Reinhard's experiments further showed that abundant hairiness of the cotton plants greatly facilitates the poisoning of the weevil, the hairs serving to catch and hold the poison and thus increase the chances that the weevil will accumulate poison particles on its mouth parts. Furthermore, this hairiness was found to impede the travel of the weevils and reduce the number of squares visited, so that even when no poison is present the hairiness of the leaves and stems affords some protection from the ravages of the weevil.

It having been found that hairiness is a desirable quality in cotton plants to be grown in boll weevil infested areas, and inasmuch as considerable difference in hairiness was found to exist in the various varieties of cotton being grown, the interest of the cotton breeder was challenged in determining what varieties have high-yielding qualities of desirable staple and wide range of adaptability and at the same time possess a high degree of hairiness so as to facilitate the poisoning of the weevil.

In cataloguing the varieties available for study, the Station and Federal investigators cooperating found that some varieties grown as experimental material such as Pima, Giza, and Sea Island, are practically without hairs, although they may possess extreme latent hairiness; and other experimental types such as Texas Green Lint and Okra Leaf have only a few hairs. A large number of the ordinary varieties common grown by Texas farmers such as Lightning Express, Half and Half, Smilie Storm Proof, Startex, Lone Star, Kasch, Mebane, Durango, Acala, and Rowden, were found to possess a medium degree of hairiness, but with the hairiness variously distributed over the plant. The Missdel types and Delfos were found somewhat hairier, whereas a few varieties, notably Red Leaf, Webb's Purple, Carver, and Tuxtla, were found to possess an extreme degree of hairiness. Of the extremely hairy types, some have been tested in the varietal plats, and last year yielded well up to the higher yielding varieties in the test. These varieties seem to offer excellent opportunity to utilize this extreme hairiness in crossing with other types that may be desired.

Experiments to transfer the hairiness of a variety to some variety that is otherwise highly desirable but in which added hairiness is desired will, according to the plant breeders, require considerable time, inasmuch as crossing and back-crossing will have to be pursued for several seasons. The process, of course, can be greatly speeded up by using the greenhouse for an additional crop

in the winter, so that the plant breeders expect to be able to bring forth a satisfactory degree of hairiness on some of the most desirable varieties now being grown and no doubt in the future with the knowledge of the desirability of hairiness in mind, they will bring forth that characteristic along with their best productions.

A most interesting approach to the development of high-yielding types that at the same time possess a high degree of hairiness has already been suggested by the experimenters, and involves the crossing of upland cottons, which possess hairiness, with the Egyptian types, which do not exhibit their possible latent hairiness until such cross is made. Certain crosses of these result in a sort of violent recombination resulting in hybrids that are hairier than even the hairiest parent. This line of attack offers a possiblity of the development of a higher degree of hairiness than the other more commonly used method of taking the highest yielding of the extreme hairy types already found, and crossing them with the hairiest of the highest yielding types, with the intention, of course, of consolidating high yield and extreme hairiness in the resulting strain.

Of course, the control of the boll weevil also involves in addition to poisoning processes, certain well established measures such as destruction of the food supply by plowing under the plants as early as possible in the fall, thus driving the insects into hibernation in a more or less starved condition, and the clean-up measures that destroy the hibernating places. The importance of early and quick maturing types of plants continues since a successful variety of this sort would help to evade much of the damage by the weevil without the expense of poisoning.

This Problem of Improvement

Condensed from The Shorthorn World

L. M. Winters
University of Minnesota

THE improvement of livestock has been, is, and will continue to be one of our major agricultural problems.

Through years of experience and keen observation many questions have been answered. We have had some of these answers for years—since the days of Bakewell, Colling Bros., Cruickshank, and others. Later breeders, and breeders of the present, have contributed to this fund of knowledge. Progress during recent years in all fields is being centered around careful research. Answers to many of the problems are to be found only through careful and tireless experimentation.

In this business of breeding livestock there is one point that should be clear to everyone and that is that it must rest on a sound economic basis. In order to put our purebred sire sales over to the commercial producer we must be able to show him without question that our purebred sire will do him more good than someone's high grade. In reality it is more than that; the strain our purebred sire represents must possess the things that make commercial livestock production profitable.

Economy of gains is as important to the stock feeder as correct type. We may brush this aside when we are striving for the blue ribbons, but the commercial producer cannot afford to pass it up. We too often have convinced ourselves that whatever type represented the ideal of the day also represented the kind that gain most economically. Usually the show type represent the market demands of the day. Unfortunately our markets do not always pay enough of a premium for that kind to make them more profitable.

Economy of gains and rapid gains are so closely related that economy of gains can be read from rate of gains. An important factor affecting rate of gain is the milk production of the dam. How much attention have we been giving to this in the development of our block animals? Not as much as we should. This is true in beef cattle, sheep, and swine. The loss

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of a newborn is a rather heavy one in all classes of livestock. Deficiency in milk production on the part of the dams is indirectly responsible for many of these losses. Heavy milking females usually do not make the most attractive looking females from a block standpoint as judged by present day standards, but after all, what is the first job of the female in the breeding herd or flock? Her job is to produce and care for healthy profitable young.

At one of our sub-stations we keep a flock of grade sheep and a flock of purebreds. The purebred ewes are bred to the pick of the sires, and yet the lambs out of the grade ewes each year outgain those out of the purebred ewes. What is more, if sold on the same market, the grades would sell for as much per pound as the purebreds. The reason this flock of grades have gained more rapidly is due mainly to the heavy milk production of their dams. Much of our selection for type in many of our better bred strains has carried us away from milk production. This is such a simple thing, but very important in the business of producing profitable livestock. In high priced purebred beef cattle we can get around it with nurse cows. Yet we all know that nurse cows do not represent sound economics.

Vigor is another factor that is of much importance in commercial livestock production. It is a rather vague and intangible term, but we all know what it means. Have we given it the attention it deserves in the development of our purebred strains?

Uniformity has received considerable attention, but who can tell us how to attain uniformity by anything but the expensive system of continual and severe culling?

Some of these problems will be solved only through long and carefully conducted experiments in breeding. Experimental animal breeding in the true sense of the term is relatively new—so new that many of us have not yet been entirely sold on the idea. There are a few things regarding experimental animal breeding that should be made clear. Many people believe that the experimental animal breeder thinks he already has all the answers to the problems of livestock production. This is far from the case. The experimental animal breeder knows only too well that he has very few of the answers. What he contends is that he knows how to get answers that will be of value to the livestock world.

Many of these problems are very old ones. They cannot be solved overnight. Much can be done by good clear thinking, but even that is not enough. Every major industry of today has a research department. Our indus-

try is just as important and just as complicated as the motor industry, the electric industry, or others that might be mentioned.

During the past few years much has been done toward organizing research directed toward answering some of the fundmental and practical problems confronting livestock breeders. In the years to come some of these experiments are bound to bear fruit. It may well be that we won't always like the fruit; we may not always like the answers. That is one of the hard features about reseach; it doesn't always yield the answer even the researcher would have predicted or even preferred (when he started).

Since experiments in the field of animal breeding are directed toward solving problems in livestock breeding, it might be well if we developed a close relationship between livestock breeders and experimental animal breeding. It might be well if we had as close and sympathetic a relationship as exists between the research and production divisions in commercial industry. Each has much to learn from the other. By a more general pooling of effort and playing all cards on the table for the general advancement of the industry we will be able to answer many of the problems that have baffled us all for so long.

The Drama of Wheat

Condensed from The New York Times Magazine

Harlan Miller

BLACK rust in American wheat fields, drought in Canada, crop estimates, official and unofficial, have lately agitated the Chicago Board of Trade, nerve center of wheat, and led to sharp fluctuation in prices. Though the nation is promised a bumper crop, "the pit" will react to every report and rumor until the harvest is in, some time in October. Our wheat reserves have shrunk, and imperiled crops in other lands have turned the eyes of foreign buyers toward the United States granary. The forecast is that the world will bid actively for American wheat. The transactions involved will be carried out by a few hundred men waving their arms and scribbling on scraps of paper in a vast oak-paneled room in the Chicago Board of Trade Build-

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ing. Beneath great blackboards they will move the price of wheat toward its destiny—by cash transactions, by speculation in futures and by "hedging." Cash deals are concered with wheat already waiting in the Chicago frieght yards or elevators; futures involve bushels promised for delivery at some later date; hedges are purchases protected against fluctuating prices by counterbalancing sales of futures at current prices.

For the 1937 drama of wheat the stage is the imposing trading room, a thirty-five-foot octagon of solid teakwood, with four high steps on the outside, a narrow platform on top and seven broad shallow steps leading down to the actual pit in the center.

As the trading begins at 9.30 A.M. something like a war-cry goes up. The buyers and sellers are trying to fill their overnight orders. Already the shiny metal visitors' gallery on the south wall is filled with pilgrims from the Wheat Belt and elsewhere. On the narrow catwalk around three sides of the room agile young men are scrawling chalk figures on the three-sided, 500-foot blackboard ten feet high; the prices at Liverpool, Sydney and other markets; the week's decrease in the visible supply; the acreages planted; the amount in storage; even the grain in the hulls of ships at sea.

Several hundred men are crowded on the octagon of teakwood. Most of them are young, and most of them wear pale tan linen jackets. They call out to one another; as eyes meet, hands dart out with fingers held in significant signals; they jot down on slips of paper the notation of the deal they have just consummated with a gesture and a nod.

Later those slips of paper will be balanced in the Board of Trade's clearing house as checks are handled in a bank clearing house. But now one of the slim hawk-eyed young men at the raised desk has caught the gesture, the buyer's signal with palm toward his body, the seller's signal with palm outward; he has flashed the price at which the wheat changed hands to the control room, whence it is flashed to several thousand glass domed tickers all over the country; to grain centers all over the world; and, incidentally, back to the men with the chalk on the catwalks, to be scrawled on the blackboards, so other traders will know of the deal just consummated at their elbows.

At the cash grain tables buyers are picking kernels of grain out of the paper bags, scrutinizing them, chewing them, deciding whether this grain will make good flour or good breakfast food or good feed. The bags contain samples from each carload of grain which arrived last night in Chicago's

railroad yards. These buyers are experts; they can deduce more from examining a few kernels of grain than many farmers could from examining a whole field of it.

In a smaller room off the main trading floor more leisurely operators sit in comfortable armchairs and watch on a smaller board a condensed version of what is going on in the big room. Telegraph messengers are dashing about, and clerks carrying notations. On the wall a ribbon of light a foot wide races past with a magnified picture of the ticker from the New York Stock Exchange.

The five-minute bell rings out; the end of the three-hour-and-forty-five-minute session is at hand. Another shout goes up, the concert of several hundred voices, trying to execute last-minute orders before the end of the day placed by exporters, millers, farmers, gamblers.

The one-minute bell rings, and now the final gong bangs out; it is 1.15 o'clock; the operators stroll over to the door. take off their linen coats. For 225 minutes they have served as the mercury in the world's wheat thermometer.

The price they now pay for that privilege is around $5,400. Seats on the floor cost $62,000 in 1929 and fell to a depression low of $3,750. Dues are only $250 a year, but the membership committee is a tougher hurdle than committees of the most exclusive country clubs; and the 1,549 members, scattered through thirty States and several foreign countries, toe the mark of a rigid code of ethics.

Neither Satan nor the speculators but the exigencies of grain marketing and transportation were historically responsible for the beginning of futures trading before the Civil War. A favorable northeast wind might then bring in many a lake vessel to chicago's waterfront at a time when, because of inadequate storage facilities, there might not be enough grain there to load. Precious time must past before the grain could be brought in from warehouses along the canals, rivers, corduroy highways or along the railroad.

Thus by 1848 the precaution had been adopted widely of buying grain in advance on a "to arrive" basis, to make sure that cargoes would be in readiness. If at the specified time—say within five to sixty days—the seller had his grain in Chicago ready for delivery, well and good. If not, it was up to him to buy grain to deliver to the buyer. If the prevailing price in Chicago on that day had risen above his contract price, then the seller was obliged to pay more for it than he was receiving. If it were plentiful,

then he might buy it for less than his selling price.

Naturally, situations arose when either the buyer or the seller was willing to accept the net cash difference between the sums involved in lieu of a transfer of actual grain. After all, money was what both were after. and it was natural that such liquid futures contracts should become the object of speculation by shrewd observers who thought they knew a thing or two, as warehouse receipts had been before them to a more limited extent. The speculators, too, were after money, and willing to take the risks. The clearing agency, to cancel the multitude of buying and selling contracts against each other, with cash payment of balances, was a logical evolution.

Hedging has removed much of the hazard from buying and selling of grain for persons who are not speculators but wish to be assured of their modest profits—though all business is partly a gamble. If a rural elevator manager has bought 25,000 bushels of wheat for cash, which he must sell in September for about $1.10 to realize his legitimate handling and storage charges, he can hedge, and does. That is he "sells" through the Board of Trade wheat pit 25,000 bushels of September futures at the current futures quotation.

If the price of wheat goes up 10 cents a bushel between now and September, he will lose 10 cents a bushel on his "hedge," but he will profit 10 cents a bushel on the 25,000 bushels he had in his elevator. If it goes down 10 cents, he will lose a dime a bushel on the wheat he owns, but will profit a dime a bushel on his hedging agreement to "sell," because he will have been able to buy his "sale" for 10 cents less than he had anticipated. Thus he neither wins nor loses whether the market goes up or down, but makes his normal profit on his actual transaction.

For this insurance the fee has been what he had to pay the brokerage house in commissions. He is no gambler; he is a cautious merchant who insures his price fluctuation risk, like the miller and the exporter.

Not long ago the Federal Government became curious to know how much of the trade in futures was speculative and how much was "hedging" or insurance against price fluctuation. It selected a fairly typical day on the Board of Trade and traced to the ultimate principals every sale and purchase of futures made that day, involving an examination of 21,283 corn and wheat accounts. The government learned that approximately nine-tenths of the accounts were speculative, ap-

proximately one-tenth were hedges.

To handle this combination of speculative, hedging and cash grain business the Board of Trade has gradually evolved its great trading machine. On active days there are often 3,000 separate price changes in the pits which are flashed to all corners of the world. Some radio stations broadcast prices nine times a day to their farm listeners.

So swiftly does this machinery work that an order from Paris has been placed, executed and confirmed back to Paris in forty-five seconds; an order in the United States has been so handled in ten seconds.

Not all the business goes on in the board room. Scouts from Chicago have been out looking at the fields, estimating probable yield, checking up on acreage planted and to be harvested, on damage from drought and pests and rust. From thousands of correspondents information pours in with such miraculous accuracy that the private Chicago estimates have been less than one-sixth of 1 per cent away from the official government estimate.

Accurate as these forecasts are, they cannot always achieve their aim of predicting what a bushel of wheat will be worth after the American harvest in October. Nature alone is not the sole criterion. The whims of dictators and financial wizards in the chancelleries, the ebb and flow of politics, the international fencing and poker-playing of the diplomats, the fate of Spain and the fate of gold, even the plans of the Duke of Windsor or the somewhat inscrutable position of Emperor Hirohito or the impulse of some unknown bomb thrower, may upset shrewd calculations.

Peculiar things have happened lately between the grain fields and the bread boxes. Corn has moved west instead of east at times; grain has had to retrace its course, back to flooded areas; alien corn cargoes have come from the Argentine, drawn by an alliance between nature and a group of thinkers at Washington. All this pushes the mercury of the Board of Trade up and down; all of it affects the white-heat of competitive bidding on the floor.

Farm Chemurgic Council

Condensed from The Farmer

Berry H. Akers
Editor of The Farmer

THE Farm Chemurgic Council formed two years ago at a meeting of representatives of science, agriculture, and industry, is now entering its third year. Its purpose it to find new uses for the products of the soil. It has approached the problem from a scientific viewpoint. Chemurgic, which is a coined word. means chemistry at work.

The task which the Council has undertaken is to solve the old problem of utilizing in industry farm surpluses which are wasted or which seriously depress prices, and the newer problem of finding new and increased uses for farm products as raw materials in industry. Perhaps the most valuable thing which the Council did in its first two years was to establish an experimental plant in Kansas for the manufacture of alcohol from farm products. Much has been said about power alcohol for use in automobiles and tractors during recent years but there has not been much definite data as to whether it can be produced profitably on a commercial scale.

Accurate figures have been obtained at the Kansas plant on the cost of making alcohol from various farm crops.

Experiments are being carried on with root crops also, and it is quite possible that they will prove better than grain for alcohol manufacture. Jerusalem artichokes will produce 375 gallons of alcohol per acre compared with 98 gallons from corn. The following table tells its own story of alcohol yield and acre value of the designated crops when turned into alcohol:

Crop	Yield per Acre	Alcohol per Bushel (Gal.)	Alcohol per Acre (Gal.)
Sweet Potatoes	300 bu.	1.05	315
Jerusalem artichokes	15 tons	...	375
Grain Sorghum	40 bu.	2.40	96
Corn	40 bu.	2.45	98
Wheat	30 bu.	2.54	76.2
Barley	40 bu.	1.83	73.2
Rye	40 bu.	2.28	91.2

Another important accomplishment has been the aid the Council has given Dr. Charles Herty in finding practical methods of making paper from quick-growing southern pine. Millions of dollars are being spent now to

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build paper mills in the South to use the native pine, and the hope is that this is the forerunner of a new industry that can make use of surplus acres and surplus people in that area.

The Council has acted as a clearing house for information about the work of other agencies in the field of chemical research. What these agencies are doing with fatty oils is of particular interest.

Chemurgic developments of the past year have centered around three oils—tung, soybean, and perilla. All three can be used in the paint industry, but thus far the bulk of the soybean oil is going into butter and lard substitutes. Perilla oil is blended with soybean oil in paints to improve the drying qualities of soybean oil. It is an imported oil, subject to the excise taxes, and its high price has retarded use of soybean oil in paints The South can grow perilla which requires long, hot seasons, and its growth is being encouraged in that section. Since we import large quantities of linseed oil and flax, considerable expansion in the production of oils for paints can be made without great damage to the flax growers.

The Council does not recommend the growing of any new crop for which industrial use has been found until the crop has been tried out and recommended for growing by state experiment stations. Whenever interest is aroused about a new market there is danger someone will begin promoting the crop before the market exists. The Council is experimenting with hemp at both Mankato and Winona and hopes to eventually develop mechanical and automatic processes of preparing the stalks for industrial use.

To date the Council has been financed entirely by the Chemical Foundation of America, which organization was created by Congress to direct the use of dye patents received from Germany at the close of the World War. The Foundation is financed by the royalties received for the use of these patents by our chemical industry. In the future, the Council, which this year was organized on a permanent basis, will be supported both by contributions from the Foundation, donations from private sources, and the annual dues of members.

The name was changed to the National Farm Chemurgic Council in order to more clearly define the scope of its activities. Regional and state councils are also being formed to handle problems peculiar to their respective territories.

How to Re-Establish Buffalo Grass

Condensed from The Western Farm Life

JUST as strip cropping holds the soil on hill and dale farmlands, so may strip sodding with Buffalo grass hold the soil of the western Great Plains against wind erosion and at the same time establish a palatable, nutritious, drouth-resistant forage crop. Agronomists of the United States department of agriculture co-operating with the Fort Hays experiment station in western Kansas have shown the way.

Buffalo grass, the natural cover on most of these plains, returns slowly on land once cultivated. It produces but little seed and these are borne so close to the ground that they are difficult to harvest. Much of the seed does not germinate.

A slow but fairly sure way to put land into Buffalo grass again is with sod pieces or strips, because the grass spreads by stolons —at an average rate of about a foot a year.

The strip sodding plan used successfully by D. A. Savage of the department at the Fort Hays station is not expensive, and furnishes pasturage and protection against blowing while the regrassing is under way.

He suggests laying 4- to 6-inch squares of sod 6 to 15 feet apart, seeding the spaces to drouth-resistant grasses such as blue grama and western wheatgrass. Other grasses that may be used are Sudan, crested wheatgrass and bromegrass. The last two are poorly adapted to the central and southern plains. Such sodding and seeding provides a natural balance of vegetation and after a year or two may be safely grazed. Some fields have been resodded successfully during recent dry years.

Some farmers who plow contour furrows in their pastures use the sod strips for resodding land that has been cultivated. Others have found that often the best sod strips are found in small, unpastured fields.

Sod may be cut into strips by machinery designed at the Hays station. Placed on a flat-bed wagon, one or two men unload the sod strips by sliding them down sheet-iron chutes into furrows or onto the surface of deeply cultivated land, where they are pressed into the soil with a heavily weighted packer. This work can be done at any time from March to August, inclusive, although the best time seems to be in March and April before spring growth starts and when there

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generally is more moisture in the ground.

Another way to start Buffalo grass is to place 4-inch cubes of sod 1 to 3 feet apart. The closer the sod pieces, the sooner the ground will be covered. About nine times as much turf is needed when the sod pieces are placed 1 foot apart as when 3 feet apart.

Wide spacing (6 to 15 feet apart) delays reclamation, but it may be accomplished economically and it provides for fairly rapid re-establishment of one of the best adapted grasses available.

Good Plows

Condensed from Wisconsin Agriculturist and Farmer

DROUTH conditions in many sections during the fall plowing season the past few years have brought to thousands of farmers an appreciation of the value of good plow equipment. Soil that would require approximately only four pounds of drawbar pull per square inch of furrow slice in the spring of the year has demanded more than twice this amount of drawbar pull when plowed in dry weather during the late summer months.

If wornout equipment has been used, costs for power and labor have been unnecessarily high and the results have been unsatisfactory in soil pulverization, coverage of trash, and loss of soil moisture as shown by subsequent crop yields.

Where timely plowing is essential for the conservation of moisture, efficient modern equipment reduces the cost per bushel of crop not ony by the saving of labor and tractor or horse power but by the larger yields which result from more thorough and seasonable work. Good plowing has a uniformity of appearance, depth, and quality which gives the farmer justifiable pride in his accomplishment. This can be achieved only with good equipment carefully adjusted and with adequate power.

Clean coverage is essential to good plowing, as leaving stubble such as grain, corn stalks, cotton stalks, etc., on the plowed surface offers protection during the winter to the many insect pests that attack these plants. When the stalks are buried so deeply that the harrows will not pull them to the surface, field control

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of insect pests is well under way.

The deeper the weed seeds are turned under by fall plowing, the cleaner the field will be the following year. The combined rolling coulter and jointer, when properly set for this work, are often a most valuable addition to the plow as this device turns all trash and weeds into the bottom of the furrow where they are most effectively covered. Rolling coulters also furnish a sharp edge to cut trash, roots, and tough soil with a minimum amount of power as well as adding to the quality of the work done.

The combined rolling coulter and jointer are also of value in effectively plowing under a heavy crop of green manure when used with the wide bottom plows. If this plowing is improperly done, the greatest good cannot be obtained from the cover crop.

Different soils and soil conditions call for various types of bottoms in order to do first class work with a minimum amount of draft, and many years of experience and large sums of money have been expended to make these available to all. Ample room for the passage of crop residues, weeds, or heavy green manure crops is provided both between the bottoms and under the beams. Heavy-duty plows are built to stand up to hard work and designed to hold their parts in alignment in the hardest of fall plowing.

Wornout equipment responds with difficulty to correct adjustment as this requires that parts be in true alignment, levers that work easily, shares which are sharp and with proper suck, and all bottoms scouring.

The drawbar of the plow should make, as nearly as possible, a straight line between the tractor drawbar and the center of the load on the bottoms. If there is a tendency for the front wheels of the tractor to turn toward or away from the plowed ground it is quite evident that the hitch is out of line and poor plowing as well as excessive wear on the tractor will result.

Where horses are used for power the line of draft should pass through the hitch on the plow straight to the point from which the animals pull. A hitch out of line, when using horses, results in sore shoulders, back and hips.

The amount of moisture in the ground, its looseness and compactness, and amount of stubble, trash, roots, and sod are all determining factors in the draft of plow bottoms. Too much moisture in the ground adds draft in the same manner as not enough moisture. An increase in speed of the plow in dry, hard plowing helps pulverization but also increases the power requirements.

Flock Improvement

Condensed from Everybodys Poultry Magazine

D. R. Marble

Pennsylvania State College

IT is always easier to improve a relatively poor strain of birds, or a weak character within an otherwise good strain, than it is to lift an average flock to a higher plane of performance. Likewise, it is easier to show improvement in a single factor than it is in several factors.

Rapid progress through careful selection within the flock, even when limited trapnesting and progeny testing are possible, should not be expected by the poultry breeder. There are many characters the visible expression of which one can complelely change in two or three generations by careful breeding, but such characters as egg production (or its subdivisions), size, shape and color of the eggs, body weight, hatchability or resistance to disease are not quickly or easily altered. Most flock improvement is slow.

High egg production is a relatively new thing. When we look about us and see our egg laying contests, our Record of Performance Associations and other similar means of determining the ability of a bird or flock to perform, we can hardly realize that they have come into existence within the space of a few years.

The first American egg laying contest at Storrs, Conn., was started in 1911. An analysis of the records made in that first year shows an average of 145 eggs as compared to 219.6 eggs last year. Twenty-five years and 75 more eggs is the story.

The average egg production of 75 birds completing a 365-day trapnest year in 1911 at Cornell University was 133 eggs. Two hundred egg hens were so scarce back in those days that there was only one chance in 20 of obtaining such a record and one chance in 636 of finding a 250-egg hen. Seventeen years later in the same strain, there was one chance in eight of producing a bird which would lay 250 eggs.

We can emphasize the newness of the 300-egg hen by again referring to the Storrs egg laying contest records. Last year 4 per cent, or to be exact 41 birds, laid 300 eggs or more or else scored 300 points.

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Prof. Wm. F. Kirkpatrick in writing about the Storrs contest records in the First American Record said, "Of the first 10,000 birds put through the traps, only one, a White Wyandotte from Rhode Island, managed to lay 300 eggs or over. That was in 1918. The second 300-egger, a Barred Rock from Ontario, appeared in 1922 and the third, a Rhode Island Red from Attleboro, Massachusetts, in 1924." This was a total of three in 13 years as compared to 41 in a single year.

All of the credit for these increases in egg production cannot be laid at the feet of the pedigree breeder. A portion of these increased results is due to a better knowledge of nutrition, housing and management. Artificial illumination has had an influence, but the key factor in this improvement has been genetic in nature.

The increase in egg production and egg size is apparent, not only in the large breeding flock, but also in the general run of farm flocks. This is particularly true in those regions of the country where there are many large breeder hatcheries.

In recent years many of the large commercial type of hatcheries have seen the possibility of passing on high quality chicks to the flocks from which their hatching eggs are purchased. This can be done by purchasing good breeding cockerels from the specialized breeder or by developing outstanding flocks in their territory, the progeny of which will serve to build up the quality of all the flocks.

The important point to keep in mind is that these commercial poultrymen or flock owners have not brought about this improvement by staying within their own strains and slowing building therefrom. I firmly believe that improvement can be made without introducing new blood every few years, but I also recognize the fact that 50 dollars *well spent* on pedigreed blood may bring about more improvement in a year or two than one can obtain through slow, methodical selection in several years.

Today there are few winning contest pens of Single Comb White Leghorns which do not trace back to one or two blood lines.

On first thought we say that this is not breeding; we call it good luck in getting the right combination. Such is often the case when a new leader steps up, apparently from nowhere, but that poultryman must be a breeder if he stays out in front over the succeeding years using only the results of his own matings.

It does not require many years of work around the pedigree table to realize that one cannot

afford to start with a mediocre strain of birds. Life is too short to hope to reach the top. However, it is much easier to find or even go out and earn the fifty dollars with which to purchase better winter egg production or a chalk white egg than it is to locate a satisfactory source of the desired character, filtering the new blood into the general flock and checking carefully by progeny test to see that it brings about the desired result.

There are many avenues by which new blood might be introduced. We occasionally hear of the winning pen at an egg laying contest being purchased with the idea of using it for foundation blood for a new strain.

Probably a more common method is to purchase a cockerel from an outstanding breeder and use him on a few select individuals.

Baby chicks are often secured or even hatching eggs find an outlet. When a brooder house pen of chicks is purchased or a sufficient number of eggs are obtained from which 250 to 300 chicks can be hatched, it is possible to have a direct comparison of the new blood with the stock on the home farm. This has many valuable features, because the new owner can accurately appraise the new blood line before it has been filtered through the entire flock. Often as a result of such a procedure the cross is never made.

The established breeder is likely to purchase a cockerel and use him on a small number of females of his own breeding. By careful watch of the progeny, the breeder can see what the cross is going to produce; in other words, how they nick. That, in the final analysis, is the only fair test.

Too often good blood is discarded before even making a cross because of a dislike for some little weakness or peculiarity of the new blood. Many times these minor faults that we find with the new blood are completely lost in the crossing of the two lines. One must watch carefully, however, to see that they do not magnify.

Bright Tobacco

Condensed from The Southern Planter

E. M. Matthews

Superintendent, Virginia Agricultural Experiment Station, Chatham

WE are told that three hundred years ago, in 1615, the gardens, fields, and even streets of Jamestown were planted to tobacco. The weed soon became Virginia's chief source of revenue and the talk of Europe and America. Today tobacco is still the chief source of income for thousands of farmers. In 1934 tobacco ranked third in income among all farm crops for the entire United States.

In 1935 the United States produced approximately 1,300,000,000 pounds of tobacco. That year Virginia produced about 105,000,000 pounds of the "golden weed"; enough to reach 60 times around the earth if manufactured into one continuous cigarette.

During Colonial days most of Virginia's tobacco was air cured or sun cured, later open fires built in trenches in the barns directly underneath the tobacco were used to aid the natural curing of the leaf and help prevent damage from mold. The very latest type of curing, that of flue curing, which today has surpassed all other methods in popularity, began in the Piedmont area of North Carolina about 1860, and grew out of the use of charcoal in place of smoke fires for curing, free of smoke, the beautiful yellow cigarette leaf. Flue curing spread rapidly in Virginia and by 1875 one Pittsylvania county expert was selling his improved formula for "Curing Fine Yellow Tobacco" in bulletin form at $6 per copy and requiring that all users of the formula be put under a $50 bond to him lest they should impart some of his secret methods of success to their neighbors.

Table I

Fertilizers per acre	Yield per acre	
	Pounds	Value
No fertilizer	216	$ 19.59
1,000 lbs. 0-8-6	485	106.90
1,000 lbs. 3-0-6	754	131.01
1,000 lbs. 3-8-0	853	230.30
1,000 lbs. 3-8-6	1106	296.61

Above mixtures each received 200 lbs. per acre of Dolomitic Limestone.
Nitrogen basis used.

Today bright tobacco is grown chiefly on the sandy loam soils of Piedmont Virginia. These soils are in better physical condition for tillage and are warmer than

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the heavy clay soils; but the more important reason why they are better for bright tobacco is that they are naturaly low in organic matter and nitrogen, thus making it possible for the farmer to supply just the required amount of nitrogen, and nitrogenous organics to feed the plant through the growing period without supplying a large surplus, which would delay ripening or cause the plant to produce dark coarse leaf of inferior quality.

During the past five years the tobacco tests conducted by the Chatham Experiment Station have been located on fairly typical bright tobacco soil of the Granville type, a sandy loam soil with yellow subsoil.

Since fertilizers are responsible for approximately 75 per cent of the yield and money value of flue cured tobacco when grown on typical soil, we cannot but realize their importance and encourage all experimental tests possible to help the farmer find answers for his many fertilizer problems.

As can be seen from the results in Table I it would be folly for a farmer to try to grow tobacco without fertilizer or to use a mixture where one of the three major plant food elements, nitrogen, phosphate, or potash, has been omitted.

Our tobacco fertilizer may be compared with a chain. It's no stronger than its weakest link.

In Table II it can be seen that where tobacco is topped low for harvesting by cutting the whole plants, or medium high for harvesting by priming, and spaced wide apart so as to produce large leaf, the heavest application of potash tested, that of 7 per cent, proved the most profitable; and increasing amounts of nitrogen proved less profitable. Where the spacing was crowded, however, to 24 inches and 18 inches, increasing amounts of nitrogen proved profitable, provided ample potash was also present to insure against low quality.

Table II. Fertilizer, topping, and spacing tests, Chatham, Virginia, 1931 to 1935, inclusive

Pounds and value per acre 5-year averages

Fertilizer		Top 10 leaves (cut)		Top 14 leaves		Top 14 leaves		Top 14 leaves	
1,000 lbs. per acre		Spaced 36 in.		Spaced 36 in.		Spaced 24 in.		Spaced 18 in.	
Plot	Analysis	Yield	Value	Yield	Value	Yield	Value	Yield	Value
1	3-8-3	671	$ 76.40	915	$157.77	968	$170.31	1021	$172.69
2	3-8-7	753	116.52	1028	200.72	1105	194.98	1087	187.91
3	4-8-6	678	101.43	985	171.25	1205	199.51	1086	187.91
4	5-8-6	590	74.79	997	170.64	1073	187.67	1086	206.77

Ammonia—not nitrogen basis used.

Table III. Varying potash—Tobacco tests, Chatham, Virginia—1931 to 1935, inclusive

Plot	Fertilizer analysis	5 Year Averages Pounds per acre	Value per acre
1	4-8-0	812	$109.65
2	4-8-4	1022	176.24
3	4-8-8	1044	179.38
4	4-8-20	1007	160.24

Note: 4 equals 4% ammonia—not nitrogen; 8 equals phosphate; rate 1,000 pounds per acre. Above results based on duplicate plots each year. The low five-year average values included two years of depression prices together with poor yields.

Table III shows the average yield per acre in pounds and the dollar value per acre for the five year period, 1931 to 1935, inclusive, for plots receiving fertilizers containing 4 per cent ammonia, 8 per cent phosphate, and potash varying from none to 20 per cent. In each case 2 per cent of the total percentage of potash shown was derived from muriate and the remainder from sulphate and sulphate of potash-magnesia. The maximum acre value was obtained when 8 per cent of potash was used. This value was 64 per cent greater than that for plots receiving no potash, and an increase of $3 per acre over plots receiving 4 per cent potash.

Although these tests show quite conclusively that at least 8 per cent of potash is profitable for bright tobacco fertilizers, yet the writer feels that an even higher percentage might have proved more profitable, if the method of application had been corrected so that all potash over the initial 6 or 8 per cent had been side-dressed just ahead of cultivation, approximately three weeks after transplanting time. The method of applying all fertilizers, including as much as 16 and 20 per cent potash, in the drill before transplanting time, resulted in a poor stand of tobacco and retarded growth in all cases of high-potash applications, thereby reducing the yield and quality for such applications.

Table IV shows just three plots taken from a series of tests conducted to determine the value of dividing the application of the different plant-food units of the fertilizer and of applying some plant-food elements about three weeks after transplanting. These tests shows that extra applications of potash as well as nitrogen, about three weeks after

Table IV. Fractional applications of fertilizers—Yield and value per acre. 1931 to 1935, inclusive

Plot	1,000 lbs. per acre Fertilizer	5 year average Yield	Value
1	3-8-5 before planting	1107	$195.52
2	3-8-5 before planting plus 0-0-5 20 days later	1318	215.64
3	1½-8-2½ before planting, 1½-0-2½ 20 days later	1265	233.89

Ammonia basis used.

transplanting time or when the crop is ready for the second cultivation, are very profitable. Similar tests conducted by individual farmers have proved equally as successful.

Numerous cases of potash deficiency were observed during the past season. Especially was this noticeable where farmers who had for years used 2-8-2 and 3-8-3 fertilizers, 800 to 1,000 pounds per acre on tobacco topped at 8 to 10 leaves for harvest by cutting the whole stalk, had changed to closer spacing, higher topping, and harvest by priming. With the old methods and yields of 600 to 800 pounds per acre no severe trouble had occurred from potash shortage, however, when the yields were increased to 1,000 to 1,500 pounds per acre whole fields often showed severe potash starvation (the plants are usually smaller in size, leaves show mottling of light yellow at the tip and edges, are often rough and puckered and may form large dead areas around the margin of the leaves.)

There is usually need for more potash in the mixtures than the unbalanced 3-8-3 offers. This mixture may be satisfactory for new soil during the first few crops or probably for a longer time where small yields are expected from low topping (8-10 leaves) with cut tobacco, or probably in some cases where a 2 or 3 year rotation is practiced with heavy weed crops to follow preceding the tobacco crop. However, where heavy yields are expected from close spacing and high topping with priming type tobacco (yields often run from 1,000 pounds to 1,600 pounds per acre) and particularly where tobacco follows tobacco annually, more potash must be used.

Tobacco is a heavy potash feeder. A 1,000-pound crop of tobacco (provided the stalks are left on the field) removes about 60 pounds of potash, while 1,000 pounds of 3-8-3 fertilizer supplies only 30 pounds. Most of our tobacco soils analyze comparatively high in total potash present, often as much as 15,000 to 45,000 pounds of potash (K_2O) in the top 8 inches of soil per acre. However, only a small percentage of this potash is available in the form crops can use immediately (often only 100 to 150 pounds per acre). The remainder may become available slowly over long periods of years which may require centuries.

Interpretations of Variations in Plant Composition in Relation to Feeding Value

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L. A. Maynard

Professor of Animal Nutrition, Cornell University, Ithaca, N. Y.

THE nutritive value of any feed is governed by its content of energy-producing nutrients, that is, its total nutritive energy, and by its content of nutrients specifically essential to the body, namely, protein and certain minerals and vitamins. Forage crops contain all of these nutritive factors, but in highly varying amounts according to species, stage of growth, cultural conditions, and other factors.

While the newer developments of nutrition have dealt particularly with the specific nutrients, it should not be forgotten that the primary role of forage crops in animal nutrition is to furnish energy. They provide a cheap source of energy which the herbivorous animal, because of his digestive tract, can utilize effectively but which man cannot.

Yield of dry matter is commonly used as an approximate measure of the ability of a given crop or soil to provide total nutritive energy for animals. It should be appreciated that, while there is a close correlation between dry matter and gross energy, several variable factors govern the extent of the utilization of this gross energy by the animal for productive purposes. As an extreme example, alfalfa hay and oat straw have approximately the same gross energy value, yet so much of the energy of the straw is undigested or dissipated as heat in metabolism that this forage has very little value for productive purposes.

The energy supplied by forage crops comes very largely from carbohydrates. This group of nutrients makes up from 60 to 85% of the dry matter, depending primarily upon the stage of growth and the species. The nature of these carbohydrates is the primary factor determining the digestibility of the feed in question and thus of the productive energy content of its dry matter. Since the nature of the carbohydrate present is governed by stage of growth, rate of growth, fertility of the soil, and other cul-

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tural factors, a consideration of these relationships becomes important.

It is convenient to divide the higher carbohydrates into three groups, *viz.*, starch, cellulose, and hemicellulose. As is well understood, starch is readily and nearly completely digested in the animal body. Cellulose, on the other hand, is not digested by any enzymes secreted by mammalian tissues but is partially broken down by bacteria in the rumen and to a lesser extent in the large intestine. In this way a portion of its energy becomes utilizable by the animal. Cellulose may occur either as such or combined as a compound cellulose of which ligno-cellulose is of most interest. Lignin is an aromatic compound which is attacked neither by digestives enzymes nor by bacteria. Thus its combination with cellulose represents an inert material which contains no energy available to the animal. Hemicellulose is a rather indefinite term which is here used to include those higher carbohydrates other than starch which are broken down by weak acids and alkalies in contrast to cellulose which is not thus attacked. Hemicellulose includes various pentosans and some hexosans. It is readily broken down by bacterial action but little or no enzymic digestion occurs.

By a rather arbitrary chemical separation the feed chemist divides the higher carbohydrates into crude fiber and nitrogen-free extract. Crude fiber consists almost entirely of cellulose and lignin together with some resistant hemicellulose. Thus its usefulness as a source of energy is dependent entirely on bacterial decomposition. Nitrogen-free extract consists of starch and most of the hemicellulose, but it also may contain some lignin and perhaps some cellulose. Thus the separation has a variable significance as regards digestibility. In some feeds where the nitrogen-free extract is largely starch this extract is much more digestible than the crude fiber fraction, but if the extract consists principally of hemicellulose its digestibility is much less accordingly. Since lignin is entirely unattacked, the higher its proportion in the crude fiber the lower the digestibility of this fraction. These facts are particularly important to bear in mind in connection with forage crops because of the highly variable nature and distribution of the higher carbohydrates in these crops. The effect upon digestibility is a more general one than that represented by the specific carbohydrates involved. Lignin is not only unattacked by bacteria itself, but it hinders the action of the bacteria upon the cellulose with which it is infiltrated. Cellulose which is not

broken down by bacterial action in turn hinders the action of the digestive enzymes on the starch, protein, and fat contained in the plant cell.

The rate of growth and stage of maturity are important factors governing the relative amounts of these higher carbohydrates present in a forage crop and thus they are influential in determining its nutritive value. In the young cell wall cellulose exists alone, but with age this cellulose becomes infiltrated with lignin and other encrusting substances. A very small increase in lignin content apparently results in a markedly lower digestibility. Lignification occurs more rapidly as the rate of growth declines either at maturity or earlier when dry weather or some other unfavorable condition retards growth. These facts explain why pasture grass is more easily and more completely digested than hay, why time of harvest is important for hay and silage, and why dry weather which retards active growth lowers nutritive value per unit of dry matter in addition to lessening the total yield. Digestion trials have shown that dried pasture grass has approximately 25% more total digestible nutrients than early cut hay. They have also shown that early cut hay has 20% more than hay cut in late bloom or in seed. There is considerable evidence that changes in lignin content are primarily concerned in these differences. The inferior nutritive value of pasture where growth is greatly retarded or stopped because of dry or cold weather, in comparison with rapidly growing spring grass, has also been explained on the basis of lignification.

It is well understood that a certain amount of protein is required in the rations of farm animals, the amount depending upon the purpose for which the ration is fed. An important advantage of legume over non-legume hay is its higher protein content, which means that less protein need be supplied in the concentrate mixture. This advantage may not exist at all, however, when pasture grass is considered, for all growing grass is rather rich in proteins. So far as is known, a protein content in excess of 16 to 18% in the dry matter of the rations of herbivora has no advantage for any purpose and there are conditions where a lower level will suffice. While a superior value in protein nutrition is frequently suggested for grass which contains 25% or even more of this nutrient, there is no basis for this belief where the grass constitutes the sole ration.

It must be immediately recognized, however, that it is inaccurate to speak of protein content in this way without certain quali-

fications. As thus commonly used, the term means nitrogen multiplied by the factor 6.25, but by no means all of this nitrogen is in protein form. Twenty-five to even 50% of the total nitrogen may be non-protein, chiefly amides and amino acids. Silage has a large amount of non-protein nitrogen, in part because of the stage of maturity at harvest, and especially because of changes occurring in the silo. The vital question with respect to the value of forage crops in protein nutrition is the significance of the forms of nitrogen present, in view of the modern knowledge that the adequacy of this nutrition is governed by the nature of the nitrogen compounds, especially the amino acids, in the feed.

Studies with rats, chickens, and man have shown that the value of a given source of protein is dependent primarily upon its supply of certain amino acids which are needed to form body proteins and which the body cannot manufacture. Thus it has come to be recognized that there are important differences in "biological value" of protein and other nitrogen compounds in feeds. We have little knowledge of the application of this concept to herbivorous animals particularly as regards the forage crops. Data for individual feeds are of limited value unless such a feed provides the sole ration because the biological value of a mixture cannot be assumed from data with respect to its constituents, due to the mutually supplementing action of various sources.

The early studies of Hart and Humphrey with milking cows indicated that differences in protein value existed when certain concentrates were combined with non-legume roughages which did not occur when clover or alfalfa were used instead. Maynard and associates were unable to find any superiority for a ration based on clover hay over one based on timothy hay where the protein intakes were held equal per unit of milk produced by appropriate adjustments in the grain mixture. With growing lambs, Turk and his associates found no differences in the biological value of the protein of clover and alfalfa fed alone or in combination with corn.

Crampton has produced evidence that pasture grasses vary in protein efficiency for the growth of rabbits and that fertilization may be a factor concerned. Morris and associates have reported that, as a supplement to a basal ration of straw, beet pulp, and oats, the protein of spring grass is superior to that of autumn grass for milk production. The general significance of these important observations must be tested by further studies.

The distribution of the nitro-

gen compounds in forage crops, as determined by chemical analysis, does not provide a basis for assessing their value in protein nutrition. The value of the protein present as such depends upon its amino acid make-up. The non-protein nitrogen which is present as amino acids may be just as valuable as the protein nitrogen, or even more so. Amides are not useless because they may be used by bacteria to build their body protein which is in turn digested to amino acids. Whether this process contributes in an important way to protein nutrition cannot be stated. It would be possible for the nitrate nitrogen to be utilized in this way. Neither chemical technics nor nutrition knowledge are adequate at the present time for estimating the protein values of feeds on the basis of determinations of their content of the various amino acids.

Of the dozen minerals required by the animal body all are present in forage in amounts which vary with the species and the stage of growth. Aside from those supplied by common salt, calcium and phosphorus are the only ones which are likely to be deficient in terms of the needs of the animal. The extent of their importance varies according to whether the forage is the sole ration or whether it is supplemented with concentrates or other feeds. In some cases the supplementary feed may automatically take care of any deficiency in the forage while in other cases this deficiency may be intensified.

The effects of a low - phosphorus content in pasture grass and dry forage upon the appetite, growth, production, and reproduction of cattle and sheep are well-known. The deleterious effects occur acutely where the dry matter contains 0.12% or less of the element. When forage constitutes the sole feed, a phosphorus content of at least 0.3% is needed during periods of maximum demand, such as growth and high milk production. When forage is supplemented with concentrates additional phosphorus is supplied in amounts which depend upon the nature of the supplementary feed. The liberal feeding of high-protein concentrates to milking cows, as is the common practice in the East, takes care of the phosphorus requirement even though the roughage contains little of the element. Where the concentrate consists entirely of corn or oats there will be a deficiency unless forage supplies a liberal amount.

In certain respects calcium presents the larger problem in practice because roughage is the only important source of this element in any ration for herbivora. No grains nor seed products are rich. The kind of roughage is the vital

factor. Despite variations, legume hay and grass are always rich in terms of the animal's needs. Since this is true, a consideration of factors which influence their content of calcium is of minor importance. The situation is quite different for non-legume hay, particularly here in the East. It is believed that where this hay forms the basis of a dairy ration it should contain at least 0.35% of calcium. Our studies indicate that much of the hay grown in New York State does not reach this figure. Fifty samples of timothy in full bloom were gathered from good and poor soils fertilized and unfertilized. On an air-dry basis the calcium content ranged from 0.14 to 0.35% with a mean of 0.24%. The dairyman who has this kind of hay must either grow some legume roughage to feed with it or else he must use a calcium supplement. These same samples of hay had a phosphorus content ranging from 0.13 to 0.28% with a mean of 0.22%.

There are no other minerals which require consideration in assessing the nutritive value of forage crops in the Northeast. While nutritional anemia can be experimentally produced in calves and lambs, it never occurs in practice in this area because the feed supply is always adequate in iron. Although goiter sometimes occurs in the new-born the iodine need is best taken care of by direct administration. Evidence indicates that the several other mineral elements required by the animal body are always supplied adequately by the commonly fed rations.

There are at least seven definitely recognized vitamins. It is important to remember that all vitamins are not needed by all species and that even when needed their importance depends upon the likelihood of their being absent from the usual feeds. Only two vitamins have been proved to be required by herbivora. Perhaps the proof has been obtained for these alone because they are the only ones which are frequently deficient in the ration. It seems probable that certain others may be needed, although they are doubtless of no practical importance in selecting rations because they are always present in adequate amounts.

All herbivora need vitamin A for growth and for reproduction and other functions throughout life. Forage crops are the principal source of this vitamin. No concentrate aside from yellow corn and a few uncommon feeds are rich. As a generalization, vitamin A activity is correlated with greenness and leafiness. Rapidly growing pasture grass is a rich source which serves to meet current needs and to provide a store in the body which can be drawn on later if the winter ration is

deficient. Non-growing, dried up grass is very poor in the vitamin and severe losses in growth, reproduction, and lactation occur where it is the sole feed.

Mature hay contains less vitamin A than does grass, but even at maturity legume hay is an excellent source and grass hay can be entirely satisfactory. Since the vitamin content decreases with maturity, early cutting is important. Even more important is the curing process. Long exposure and a loss of leaves means a large destruction of the vitamin. Field curing causes considerable loss at best. Artificial drying is much less destructive. Converse and Meigs have shown that No. 3 timothy hay is so poor in vitamin A that the milk produced from cows fed on it will not support the growth of calves. A very poor grade of alfalfa hay may be inferior to a properly cured, early cut timothy. There is a gradual loss of the vitamin in storage with the result that old hay always contains less.

Silage may supply a considerable amount of vitamin A depending upon the stage of maturity, the amount of grain present, and the nature of the changes occurring in the silo.

Vitamin D is needed for the growth of all herbivora, but has little or no proved value as an aid to calcium and phosphorus nutrition in the mature animal. No amount will overcome the mineral losses which normally occur during heavy milk production and massive doses are required to increase markedly the vitamin content of the milk.

Animals which are regularly exposed to sunlight during the summer are adequately supplied with the vitamin in this way and the content in the feed requires no attention. In barn feeding the nature of the ration becomes important, and forage crops provide the only source of the vitamin unless special feeds like irradiated yeast are used.

The vitamin D content of forage depends entirely on exposure to the sun. The growing plant contains none of the factor, but it contains precursors which are transformed into the vitamin during sun curing. Thus the curing process is all important. Fairly rapid curing in bright sunlight gives the best results. Artificial drying produces a less potent product because of the limited exposure to the sun. On the other hand, prolonged exposure in the field is also deleterious, particularly if bad weather extends the curing process. When cured under the same conditions, legume hay develops much more vitamin D than does nonlegume roughage, but even the latter, if properly cured, can supply enough to meet the needs of the growing animal.

Range Conservation and Reclamation

Condensed from The Montana Farmer

John C. Page
Commissioner of Reclamation

THE agriculture of the 11 western states is largely confined to two distinctive types, irrigation farming and grazing. The amount of forage produced on the public and private pastures and by irrigation, despite the tremendous disparity in the acreages devoted to each, is almost of equal value when measured in feed units. Thus each is of equal importance to the livestock industry.

Although irrigation and grazing are totally dissimilar, in this arid and semi-arid region they are closely related and interdependent. Without irrigation the forage and feed necessary to carry through the winter the numerous flocks and herds using the public domain could not be provided economically. Conversely, the gigantic livestock industry in the west is a pillar of support for the irrigation farmer, without which his efforts to make a living and to build up the western communities would surely fail.

Together these two comprise a single program upon the success or failure of which rests the future of one-third of our country.

Let us consider briefly the west's situation. These semi-arid states have more than 700,000,000 acres, but only 4 percent of this vast area is cultivated in both dry and irrigated farms. Approximately 18,000,000 acres are irrigated. They have, however, 539,800,000 acres, 72 percent of their area, which can be classed as natural pasture, useful for grazing. Of this 347,000,000 acres are federally owned.

Ninety-five percent of the acreage irrigated in the United States lies in the western states. Likewise, 95 percent of the public pastures is concentrated here.

We have in this western region built an amazing industry through the combined use of our public ranges and our irrigated farms. Its security must be safeguarded or the whole west will suffer.

In 1902, with the passage of the federal reclamation law, water was recognized in this area as a primary resource and its conservation and prudent use as a national problem. It was much later,

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however, that the nation as a whole awakened to the necessity of protecting and conserving the west's second major resource—its public pastures. When President Roosevelt signed the Taylor grazing act in 1934, authorizing the regulation of 165,000,000 acres of federally owned pastures, the second major bulwark against misuse and exhaustion of the western resources was erected.

Since this law was enacted, the first real progress toward stabilizing the public land ranges has been made. Forty-nine grazing districts encompassing 110,000,000 acres and each about as big as Connecticut have been organized. Stockmen themselves have a very large part in the administration and policing of these districts. Long strides have been made toward eliminating overgrazing, which only a few brief years ago was a real threat to destruction of the public pastures. In 1936 a 13 percent reduction was made in the number of livestock using the regulated ranges. In one year the total number of cattle and sheep on these pastures was trimmed by 1,169,474 head, and this was done largely by the awakened livestockmen themselves.

The significance to the irrigation farmer of this new and promising development in our somewhat checkered history of public land administration should be obvious.

In the first place, conservation of the ranges means perpetuation of the livestock industry, and the irrigation farmer must have the livestock industry.

In the second place, it means that the brakes on erosion, which were loosened by overgrazing, will again be applied. Reservoirs, canals and the very water supply upon which the irrigation farmer relies can be destroyed by the erosion of the soils from the watersheds to be deposited in the channels which serve him.

And third, the shift in cover from the native grasses to such dangerous weeds as the Russian thistle and the mustard plant because of overgrazing not only reduces the value of the ranges, but may also damage irrigation projects in adjacent areas. The sugar beet industry recently was driven from some sections of Idaho by the white fly. There is much evidence that this occurred because mustard and Russian thistles, which harbor the white fly, had taken over large areas of overgrazed ranges in the vicinity of the afflicted areas.

There is no conflict between the interests of the users of the public pastures and the irrigation farmer.

The animosity between the irrigation farmer and the livestockman died with the time when western men did their thinking with their trigger-fingers.

Johne's Disease

Condensed from Pacific Rural Press

JOHNE'S disease, chronic bacillary diarrhoea or pseudotubercular enteritis, is a chronic infectious inflammation of the small and large intestines, affecting cattle particularly, but sometimes sheep, goats, and deer. It is characterized by the appearance of a persistent diarrhoea, gradual emaciation and great weakness, and is caused by the bacillus of Johne's disease. It is world-wide in its distribution, but it is more prevalent in some districts than in others.

It is caused by Mycobacterium paratuberculosis, which is in many respects very like the tubercle bacillus. Like the latter, it belongs to the class of "acidfast" bacilli, is similar to it in shape and size, and to some extent in its cultural characteristics. Infections take place by way of the mouth through foodstuffs contaminated with excreta from other infected animals. Pastures, stagnant water, ponds, and animal buildings may harbor the germs for long periods.

The disease is very slow in its onset. Cattle that have become infected may not show any symptoms for as long as two years after the last case occurred on a premises, and it seems probable that not all animals that are actually infected develop definite symptoms. The first signs of the disease are loss of condition, general unthriftiness, a harsh, staring coat, and a laxness of the bowels, in spite of good food and a well-balanced ration. Milk cows, goats and ewes, give less milk, and if suckling their young these latter may show similar symptoms. This state may last for a considerable period and the name of "piners" or "wasters" is popularly applied to such animals. Later, the symptoms become exaggerated. The temperature fluctuates a degree or two above the normal, the animal refuses food some days, but eats ravenously on others. It is about this time that emaciation begins to become very marked. The flesh wastes away, leaving the bones sticking up from the skin in a remarkably prominent fashion. Weakness and general debility become more and more pronounced, until some day the animal lies down and is unable to rise.

Much of the loss, both direct and indirect, can be avoided by the early diagnosis and the

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slaughter of affected cattle. In this way, the carcass value may be saved, provided emaciation is not great. There is no cure for the condition when once well established; the disease is invariably fatal sooner or later. Where breeding (or other) value warrants an attempt at treatment, the animal should be isolated in a shed or loose-box and fed upon as highly concentrated nitrogenous food as possible.

Great attention should always be paid to the prevention of infection to other animals, especially calves.

Horse Bots

Condensed from The Dakota Farmer

N.D.A.C. Circular No. 148

F. Gray Butcher
Extension Entomologist

THE annoyance which botflies cause to horses and mules, while the flies are depositing their eggs, has aroused the interest of stockmen in methods of controlling these insect pests. A practical knowledge of the life cycle and the habits of these insects, which in their larval or maggot stage are the well-known bots, is essential in administering control measures.

The adult botflies all resemble bumblebees in appearance, being about two-thirds of an inch long, very hairy, and of a general brownish color, with bands of lighter-colored hairs across the abdomen and around the thorax.

There are three different kinds of botflies which attack horses, the nose botfly, and the throat botfly.

The nose botfly is the most annoying. The adult of this species is slightly smaller than the adult of the other two species, and in general is darker in color. There is a distinct yellow band across the base of the abdomen, and the tip of the abdomen is bright orange in color. The common botfly adult has a somewhat lighter-colored abdomen and has faint smoky spots in the wings. The throat botfly adult may be recognized by the rust-red color of the thorax and a prominent black band across the center of the abdomen.

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The nose botfly lays its eggs very close to the skin on the small hairs of the lips of horses. These eggs are black in color and have a slender screw-like "tail" which is clamped around the base of the hair to which the egg is attached. The eggs of the common botfly are attached to hairs around the front legs, shoulders and manes of horses. These eggs are yellowish in color and are attached somewhat obliquely with the basal two-thirds of the egg closely appressed to the hair.

The throat botfly attaches its eggs to the hairs on the throat or under the chin between the jaws. These eggs are also yellowish in color, but they are attached to the hairs by practically their entire length and lay almost parallel to the supporting hairs.

The life histories of all botflies are similar in that the immature or larval stages are found in the stomachs of horses and mules during several months of the year. The adult flies appear sometime in June and are present throughout the summer months, often until heavy frosts in the fall. The individual flies are short-lived, usually living but a few days. However, during this short period they are extremely active, with the sole purpose of egg deposition. Their mouth-parts are so reduced that they do not take any food but exist entirely on food material assimilated during the bot stage in the horse's stomach. Each female fly is capable of producing from 150 to 750 eggs.

In laying eggs, the nose botfly darts at the horse's lips, deposits a single egg, and then flies away for a few seconds. Horses will often be followed long distances by these flies.

The common botfly usually remains about the horse almost continuously while laying eggs, flying from place to place as it cements egg after egg to the hairs. Often several eggs will be attached to a single hair.

The throat botfly frequently poises in mid-air near the forelegs of the horse, then darts rapidly to the throat and attaches from one to four eggs at a time. After an attack, the insect flies away quickly, only to appear again in a few minutes and repeat its attack.

The eggs of the common botfly require moisture, a rise in temperature, and probably friction before hatching. These requirements are met when horses lick themselves or each other. After the eggs are about a week old, the young bots emerge immediately upon contact with the moist tongue or lips of the horse and are readily taken into the mouth. If favorable opportunities for hatching are not immediately available, embryos within the eggs may remain dormant for several months, but will hatch at

any time when contacted with the horse's tongue. The larvae of this species burrow into the flesh of the tongue or into the mucous membrane of the mouth. About a month after being taken into the mouth, they find their way to the stomach where they attach themselves to the lining of the stomach, usually to the white covering of the left sac or along the ridge between the right and left sacs.

The eggs of the nose botfly are ready to hatch within 5 or 6 days after being deposited. The moisture and friction available to those eggs laid near the edges of the horse's lips hasten the hatching process. The young larvae of this species find their way into the horse's mouth by their own action and with food and water taken by the horse. Apparently, they are swallowed with food or water and thus find their way directly to the stomach. Here they likewise attach themselves to the lining of the stomach, usually being found most abundant near the pyloric or exit end of the stomach. Some are occasionally found in the first or duodenal section of the intestine.

Apparently, the small bots hatching from the eggs of the throat botfly under the throat or chin crawl down the jaw of the animal and into the mouth. They are found in the stomach shortly after hatching, usually attaching themselves to the lining near the exit end of the stomach. Occasionally bots of this species attach themselves in the pharynx, and frequently they pass through the stomach and attach themselves in the first section of the intestine.

After establishing themselves in the horse's stomach, the bots remain there for a period of from 8 to 12 months while they feed and grow. These insect pests do all their feeding in the alimentary tract of the host animals, food being assimilated through the body walls of the bots. When full grown, the bots are about three-fourths of an inch long, yellowish white to pinkish in color, and have a thick tough skin with circlet of prominent dark-colored spines around each body segment. Throat bots are somewhat paler than the other forms. When the bots have completed their growth, they release their hold on the walls of the stomach and pass on through the alimentary tract, finally falling to the ground. The nose bots usually detach themselves from the stomach walls shortly before maturity and pass back into the rectum, where they re-attach themselves for a short period. At maturity, these bots have a tendency toward a final re-attachment along the margin of the anus. Here they remain for a day or two, and then release their hold and drop to the ground individually. The other forms, i. e., the throat bots and the com-

mon bots, normally pass out of the body with the dung, apparently not re-attaching to any portion of the intestines after they leave the stomach as mature bots.

When the bots reach the ground, they seek protection by burrowing into the soil just deep enough to escape the direct rays of the sun. Within a few days, the transformation into the resting stage, or puparium, is made. The duration of this resting stage varies according to temperature and other factors from about three weeks to two or three months. Then the adult flies emerge, completing the cycle.

Most farmers and most stockmen recognize the annoyance caused to horses by the egg-laying habits of the botflies. This is often a serious matter, especially when the nose botfly is concerned. Frequently, otherwise quiet teams become unruly when this fly attempts to deposit her eggs, and persistent attacks on horses on open ranges will be the cause of mad stampedes. All horses have an instinctive fear of botflies of all kinds, but the common botfly causes far less excitability than the throat and nose botflies. Horses attempt to seek protection in characterisic manners. They will come together in shady places and, if nose botflies are bothering, rest with their lips upon each other's backs. If throat botflies are causing annoyance, horses commonly rest their heads over each other so as to protect the throat and under sides of the jaws.

The most serious damage from botflies is due to the injurious effects of the bots while they are attached in the horse's stomach. Here they live on the food which the horse eats, and in this way rob the animals of food which they have taken for their own use. The continued irritation at the points where bots are attached to the lining of the stomach often gives rise to inflammation and ulcers. Colic and other digestive disturbances may be due to bots.

The degree of injury to an animal will depend upon the number of bots present. Very commonly, several hundred bots may be found in a single animal. Occasionally bots are so numerous and attached in such a manner that they block the passage of food.

There is an effective method of destroying bots while they are in the stomachs of the horses. However, this must be done while all of the bots are in the animal's stomachs. This period is between the time the last bots reach the stomach from those eggs deposited during late summer and fall months, and the time the first of the nose bots leave the stomach to finish their development

farther down the intestinal tract. From late November until early February, is the period when most effective control can be done.

The treatment consists in the administration of carbon disulphide into the stomach of the horse. This material forms a gas which is fatal to the bots, but, in the quantities used, is not harmful to horses or mules if they are not suffering from some other ailment.

In order for the treatment to be successful, it is necessary that all bulky foods be out of the stomach. This can be done by starving the animals for a period of at least 18 hours before treating. During this starvation period, they should not have access to hay, straw, forage, or grain, but they may have water. Then the carbon disulphide is administered, either by capsules or a stomach tube, using 1.5 fluid drams (6 cubic centimeters) for each 250 pounds of body weight. The correct dosage may be administered in a single treatment or in two treatments at 2-hour intervals. Do not allow the animals any food or water for about 3 hours after treatment.

It is recommended that this material be administered by a trained veterinarian, who can recognize any other illness in the stock, and also will know how to get the chemical into the horse's stomach. Horses are occasionally killed by unskillful administration of the material so that the treatment of horses by the owner is inadvisable.

Carbon disulphide is a poisonous, inflammable liquid, and its use by an uninformed or careless person is hazardous.

If the animals are treated in the early winter, it is probable that there will be several eggs of the common botfly around the forelegs, shoulders, etc., which have not yet hatched. Since the eggs of this species remain viable for some time, it is advisable to destroy them in order to prevent reinfestation. This can be accomplished by applying warm water to the parts of the animals where these eggs are attached. The moisture and the sudden rise in temperature stimulates an immediate hatching of all unhatched eggs and the young larvae will not be in a position to cause infection. The water should be heated to a temperature of 118 degrees, and the treatment will be most effective if done on a day when the air temperature is below 60 degrees. The infested areas on the animals should be bathed thoroughly, using a sponge or piece of cloth dipped frequently into the warm water.

The Wax Method of Plucking Poultry

Condensed from New England Poultryman

Thomas W. Heitz

Marketing Specialist, Bureau of Agricultural Economics, U. S. Dept. of Agriculture

EXPERIMENTATION in the wax or adhesive method of plucking poultry began in the United States about ten years ago, but the use of the method did not become general until about 1933. At that time some of the larger packers in the country adopted this method of dressing. The development and improvement of the highly efficient wax that is used and the manufacture of machinery and equipment for properly handling it are the results of a great deal of experimentation. The principal problem was to obtain a wax that would solidify rapidly after the poultry was dipped into it, and would not be so brittle that it would break when it hardened, would not discolor the poultry, and would be so adhesive that it would remove the feathers when it was pulled from the bird. The wax or combination of waxes used in the formula must be such that it will stand re-melting and re-working in order that the same wax may be used over and over again.

In practical operation the method of plucking begins in the same way as in ordinary slack-scalding of poultry. After the poultry is bled and the tail and wing feathers are removed, the birds are hung on shackles and are run on a moving chain through a slack-scalding tank for a period of about 33 seconds. The temperature of the water used in scalding is near 128 degrees Fahrenheit. Immediately after coming from the tank, and while moving on the endless chain, the birds are "roughed" by hand pickers to remove most of the larger and heavier feathers. When all but the smaller and pin feathers have been removed, the chain carries the chicken into the dryer.

The machinery most frequently used in the drying conists of two sections. The lower section provides for the intake of fresh air. In the upper section a strong blast of warm air is blown on the birds by fans. The drying is accomplished by the warm air being forced through the upper section at high velocity. The bird is conveyed back and forth in this section or tunnel through a strong movement of air, two, three or four times, depending upon

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whether the dryer has two, three or four tracks. Two high - speed fans are used, one for warm and one for the cold air, which, in the larger units, move 300,000 cubic feet of air per hour up the tunnel. The drying is accomplished principally by air movement rather than by heat, thus eliminating the possibility of burning the skin or drying it too much. Fresh air is brought from the outside of the building and is piped into the dryer behind the heater. It is then forced through the steam radiator, where it is heated to approximately 100 degrees Fahrenheit. The heat is automatically controlled by a thermostat on the steamline that enters the radiator.

The framework of the dryer is made of ¼-inch galvanized angle iron. The outside walls are of extremely heavy galvanized sheet iron. The inside is lined with a layer of ½-inch insulating board to reduce the heat to a minimum.

After the poultry emerges from the dryer it continues on the endless chain, passing over the automatic vat or tank which contains the wax. As the conveyor carries each bird over the tank the tank is raised so that the warm liquid wax covers the chicken. The tank is then lowered, the bird continues on its way, and is "dipped" a second time almost immediately. The shackle that fastens the bird to the endless chain is so arranged that both the head and the feet are higher than the other parts of the carcass. Hence in the process of dipping the head and the feet are not submerged. The wax in the vat is kept to a temperature of near 128 degrees Fahrenheit, and this temperature is also under thermostatic control. About ten ounces of wax adheres to each medium-sized chicken. The tank is automatically refilled by an inflow of the melted wax.

Soon after emerging from the second waxing the bird is conveyed into a spray tunnel, which is similar to the dryer in construction. A number of spray nozzles are attached at the bottom and the top of the dryer tunnel and on both sides at intervals of four feet. They are adjusted to focus a spray of clear, cold water directly upon the birds as they pass through this tunnel. This cools the wax almost instantly.

The wax is now ready for removal. It is pulled from the poultry carcass by hand operators, who require only a few seconds for each carcass. As the wax is removed the remaining feathers, hair and dirt are removed with it. The wax removed from the carcass falls to the tables placed directly beneath the chain, where it can be gathered and remelted for further use.

Spoiled Hay Is Fire Risk

Condensed from The Washington Farmer

Jerry Sotola

HAY stored when damp or "green" is dangerous. A moisture content of 25 to 30 per cent is considered the danger zone with loose hay, and less than this for chopped hay. Bacteria may make the hay hot but cannot set it on fire. They are destroyed by their own heat before the hay even chars.

If the stack contains no air, it does not heat; if it has an excess of air, it is safe. But if a little air reaches the oxygen - hungry gases, they absorb it eagerly, generating more heat. Should a large supply of air suddenly reach them, they are apt to react with the oxygen so energetically as to produce flame. Numerous other factors enter in, and the explanation is by no means a simple one.

Large hay stacks offer more opportunity for spontaneous combustion than smaller ones, because of a wider range of moisture and pressure. This is especially true of chopped hay. Heavier hays such as alfalfa and the clovers are more likely to heat than the hollow-stemmed grain hays.

By salting the hay, there is a slowing down of the generation of heat. However, the hay should be dry. Too much reliance must not be placed on the salt. The salt keeps down the growth of molds which cause musty hay, and it also adds to the palatability. Feeding experiments show that 15 pounds of finely ground hay salt is sufficient per ton of hay. The salt must be evenly distributed. More salt than this is not advisable. A steer eating 30 pounds of hay daily, which has been salted at the rate of 15 pounds per ton, is consuming 3.6 ounces of salt which is well above its actual daily requirement. If one were to salt very wet hay sufficiently to insure its keeping quality, it would be unfit for feed.

In case of doubt as to safety in storing rain-damaged, musty hay, it is a wise precaution to stack the hay for a period of five to seven weeks out-of-doors, thus permitting it to go through a "sweat." Such hay is then safe for chopping into the barn. Such a plan means extra labor, but in the long run it is much worth while.

Feed the poorest hay early in the fall. It does not improve with storage and the animals are in

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good shape, carrying food reserves over from the pasture season. Also the poor hay may be blended with the greener, brighter hays.

Bleached, discolored and water-soaked hay has suffered much in value. It has lost aroma, is not very palatable, is low in minerals and it is conceded that from 50 to 75 percent of its vitamin A value is gone. Loss of color and loss of leaves indicates poor hay.

Off-grade hay is consumed more readily if chopped, since fresh surfaces are exposed and the palatability is improved. The weathered hay may be rendered quite palatable by moistening it with cane or beet molasses water. Ordinarily the molasses is diluted two and one-half to three times with water.

Chopped Hay, Properly Stored, Reduces the Fire Hazard

F. J. Kruetzer

TODAY, ninety - six farm buildings will be destroyed by fire somewhere in the United States! Every twenty-four hours this devastating toll is exacted. According to the National Board of Fire Underwriters, a farm structure succumbs to fire every fifteen minutes. Starkly, these tragic, smoldering ruins scar the rural landscape. The annual loss of farm buildings is estimated at close to $150,000,000, about one-third of the yearly national loss.

This shattering of a farmer's hopes every fifteen minutes destroys 2880 buildings every month—34,560 every year. And that is not all. Tens of thousands of cattle, sheep, hogs, horses and chickens are also destroyed each year. The blood lines represented in a lifetime of breeding and selection—whole herds of dairy cattle and other animals, are wiped out! The farmer's livelihood, together with his hopes and ambitions are sacrificed.

Because these terrific losses are scattered over wide areas, often in isolated places, the true extent of the tragedy is seldom fully realized. Because of the isolation, fire fighting facilities are seldom available to farm people. A barn or other structure which catches fire is usually doomed to complete

destruction. Insurance rates are naturally high for ordinary farm buildings. Because of this fact, a farmer is seldom protected with full coverage. Even if complete protection were carried, every burned out farm structure represents its value in wealth definitely destroyed, never to be replaced. Insurance, though highly essential, replaces no lost wealth. It merely distributes the loss among many policy holders.

The old hay loft over the stable is responsible for a large share of this loss. Leguminous hay crops, to be of real value, must be harvested with a reasonable moisture content. If placed into hay loft storage with too high a moisture content there is always the danger of self ignition due to over heating in the curing process. When a barn is thus spontaneously fired, the entire structure is doomed, often including valuable livestock, all crops and equipment.

Aeration of the hay mow to liberate excess heat, gases and vapors, was never feasible where bulk hay was stored. The cost of providing ventilating flues for such large masses was prohibitive.

Chopping hay and blowing it into storage, a practice in use for many years, because it requires only about one-half the storage space need for whole hay, offered new possibilties. Alert farmers in all sections of the country have used this method of storing hay in barn lofts for many years as a means of better crop utilization at lower handling costs. The ensilage cutter is, of course, a familiar machine to most farm people. The first chopped hay was put up with an ensilage cutter. Today with the quite general acceptance of chopping hay as a regular practice, manufacturers of ensilage cutters have developed and perfected a machine especially for hay chopping. It does a better, faster job than the old ensilage cutter. It is also adaptable to chopping ensilage.

Chopping hay does away with the hardest, most disagreeable farm task, that of mowing away hay in a hot, dusty loft. With distributing pipes, the placement of which is occasionally changed or re-directed, a loft may be easily filled. Because of the greater density, however, of chopped hay, it is highly important that it be stored in small masses, to allow aeration. If the hay does not actually heat to the firing point, there is danger of nutriment destruction in a browning process.

Some five years ago, a new type of storage unit was designed by the engineers of the Jamesway Company to handle chopped crops. Because of the fact that chopped crops required much less storage space per ton, possibilities

presented themselves for ventilating the hay. Narrow masses were entirely feasible if the right design for a container could be evolved. After diligent research, the engineers hit upon a cylindrical structure as the solution. This structure was built of iron, heavily zinc coated, for long service and to eliminate the expense of painting. This unit was so designed with inner compartments and ventilating flues, that there would always be an outlet for excess heat, gases and vapors, making the possibility of spontaneous firing very remote. If, however, due to careless operation, or for any other cause, fire should break out *it could be controlled and confined,* thus offering an opportunity of saving adjoining buildings.

Chopped hay should be cut and cured in the field in exactly the same manner as is employed when long hay is stored. The moisture content should not exceed that allowed in ordinary haying methods. The machine knives should be set for a one and one-half inch cut.

Most farmers agree, that chopped hay is easier to place in storage; easier to get from loft to manger and, best of all, there is less waste in feeding. Animals eat every bit of it, stems included.

All forms of hay-eating livestock like chopped hay and thrive on it. For best results, however, care should be taken, to secure the safest possible storage.

How to Recognize and Control Blackhead

Condensed from Turkey World

S. W. Hamilton

BLACKHEAD, which is more commonly found in turkeys than in other fowl, is an infectious disease which affects the tissues of the intestines, liver and cecum (blind gut). Blackhead is associated very closely with the turkey industry and unquestionably has resulted in a greater loss of birds than any other disease.

Turkeys of all ages are susceptible, and mortality in young birds will be in proportion to the method of rearing. However, losses of 75 percent or more are common, particularly with birds on range. Infection can occur with poults one month of age and the mortality will usually be higher with the youngest birds. Older turkeys, although always

susceptible, apparently have a greater resistance to the infection. Blackhead is now referred to as Infectious Enterohepatitis, and is caused by a microscopic protozoan (a small organism consisting of a single cell) called "Histomonas Meleagridis Tyzzer."

The name blackhead is most misleading as it cannot be definitely associated with a definite symptom of the disease. A turkey with dark, black or purple-colored head should be considered only as a *possible victim of blackhead,* as such a reaction is not always a true indication, and is often noted as a symptom of other diseases. Symptoms can only be definitely identified through diagnosis by a recognized laboratory. There are, however, certain external symptoms which are quite constant and typical of blackhead infection.

With young turkeys, the invasion of the infection can be of such rapidity that a bird may suddenly die without showing any particular manifestations. Mortality with poults can take place within two to four weeks after exposure to the infection. With older birds, the disease is not always as fatal and will be of a more chronic nature, thereby showing a limited number of symptoms. The most commonly known and first recognized symptoms associated with blackhead are as follows: indifference to food consumption, weakness in walking, ruffled feathers, drooping wings, increased thirst, drowsiness, eyes shut, watery and foamy diarrhea (light green to yellowish brown in color), emaciation (loss of weight) and a possible discoloration of head skin.

In order to conduct a successful post mortem examination and not destroy or mutilate the internal organs, it is necessary to open the bird correctly. Post mortem examination of any specimens, whether sent to a laboratory or conducted at the farm, should be made as soon as possible after death occurs.

First, cover a flat board or top of a barrel with some newspaper or old bags which can later be burned. Place the bird, keel up, on top of this material, and then with a sharp knife cut the skin between the thigh and body on each side. Break down the legs so that they lie flat, or away from the body. Insert a knife underneath the skin at the end of the keel bone and draw upward to cut through the skin and feathers. Peel the upper skin, including feathers, forward and pull the lower skin backwards. This will expose the breast. Take a pair of sharp shears, cut through the skin at the end of the keel bone, then along and down each side of the ribs well into wing joints, but avoid injur-

ing lungs or cutting into intestines and liver. Pull the breast forward and this will expose primarily the lungs, heart and liver.

The liver of a turkey with blackhead will, in some cases, adhere to the other internal organs and will also show some enlargement. *The most characteristic manifestation of the disease is the appearance of depressed grayish-yellow or yellowish-green ulcer-like areas on the liver.* The size and number of these areas will vary from less than one-half inch upward and may involve the entire surface of the liver.

After closely observing the condition of the liver, remove the intestines by cutting through the enclosing membrane, and this will expose the caecal tubes (blind guts) which are near the lower end of the intestine. The caecal tubes will, in most cases, be ulcerated, enlarged, thickened, lumpy, hemorrhagic (bloody), and filled with a cheesy or dull gray core. The whole or parts of the caecal tubes may be involved. If both the conditions which have been described are found, one can be relatively sure that blackhead is the causative factor.

For many years, definite modes of transmission of blackhead were unknown. Research investigators later demonstrated that the caecal worm egg was a carrier of the disease - producing organism, as was contaminated soil, litter and feed and that these were definite factors for introducing the disease.

As chickens are known to be commonly infested with caecal worms (a thread-like worm about one-half inch in length), turkeys should be prevented from coming in contact with ranges or any other equipment associated with chickens. Chickens or turkeys which are infested with caecal worms containing the blackhead organism eliminate numerous quantities of worm eggs that contain the infection, have a very thick shell and are most resistant to natural weather conditions. The caecal worm egg can harbor the blackhead organism in the soil from year to year. This is why every precaution must be taken to avoid using contaminated ground or constantly ranging turkeys on small areas. The blackhead organism, however, if unprotected, is soon destroyed after being exposed to natural weather conditions.

Caecal worm eggs take from seven to ten days to incubate if conditions are favorable. After the eggs have gone through the incubation period, they can be taken into the body of turkeys through the feed, water or any foreign material consumed by the turkeys. The caecal worm egg is then deposited, after it has been picked up by the turkeys, in the caecal tubes, where the blackhead organism is released.

Blackhead is also known to infect game birds, such as pheasants, quail, grouse, pea fowl and guinea fowl, and these should be considered as potential sources of introducing the disease.. Turkeys which have recovered from a previous infection are a constant means of introducing further trouble. Some of the latest research work indicates flies as possible carriers.

Blackhead can also develop in turkeys raised in complete confinement off the ground, without the presence of caecal worms or any association with mature turkeys. This would indicate other unknown mediums of introduction.

Prevention of blackhead is more desirable and effective than any known methods of treating diseased birds. Three types of rearing programs to control blackhead are now being used with turkeys in the various producing areas. First, confinement rearing has been the most effective method and has also demonstrated itself to be commercially practical. Colony or long brooder houses combined with rearing porches covered by wire are now commonly found in the eastern part of the United States.

Second, the semi-confinement method of rearing has become very popular. It has some advantages over the complete confinement system, in that less brooder house space and equipment is needed. The poults are started in complete confinement and are reared on the outside wire porch until they reach the age of 10 or 12 weeks. Poults are then put on clean and rotated range to finish their growing period. It has been demonstrated quite definitely that after poults reach the age of 10 to 12 weeks they are less susceptible to blackhead and other diseases and parasites.

The third method is rearing on uncontaminated ground or ground which has not been used continuously by either young or breeding birds. No sun porches are used and the poults are allowed on the ground as soon as they are old enough to get outside of the house. This method, although similar to the semi-confinement system, requires more labor, acreage, and a greater observation of the birds.

A good growing range should have, if possible, a permanent cover crop and be well drained. The number of turkeys that can be grown per acre will depend on the amount of range available and on previous usage. If a turkey grower is limited in range, he can safely raise 75 to 100 turkeys through to maturity on one acre, but the growing turkeys should be allowed to range only one-quarter of the acre at one time.

Blackhead is difficult to treat

after it once becomes established within the internal organs. Proper rearing management seems to be, at the present, the most effective procedure.

Vaccines have not been developed to be commercially practical. Experimentally, the removal or occlusion of the caecal tubes has, from a laboratory standpoint, been successful in preventing blackhead infection with turkeys, but cannot be recommended at this time as a practical method for the commercial producer.

Tobacco powder, no doubt, has been advocated or used more than any other product as a method of control. The value of a tobacco powder depends on the nicotine content, which should be not less than one and one-half percent. In order to secure the greatest efficiency, tobacco powder should be mixed in a mash once a week and preferably twice. Anyone using tobacco powder should keep it in an air-tight can until included in the feed. From 2 to 4 percent of tobacco powder usually has been recommended. Progressive increases of tobacco powder have been tried out but resulted in no absolute curative or preventative benefits. Gradually increasing the percentage of tobacco powder helps to prevent an immediate dislike for the mash, as the use of tobacco powder in a ration makes it more or less unpalatable. A nicotized powder is now available on the market. It is taseless, odorless and retains its potency for a considerable period of time even when mixed with a feed. The actual results, however, which can be secured from any tobacco powder are still experimentally and commercially questionable.

One of the most effective treatments recently advocated is to give an infected flock a ration containing 40 percent dried skim milk for a period of two to three days, depending on the age of the birds. Any ration in pellet or mash form, especially formulated for the control of coccidiosis, in chickens or other birds, can be given. Remove all the other mash and all grain during the treatment. Clean the pens every day during the treatment and the day following it. The birds should then be moved to as clean range as possible.

Intestinal antiseptics and astringents now recommended appear to have moderate helpful value if administered within a few days after the milk flush.

Always remember, first *remove* or *isolate immediately* individual birds which do not appear to be in normal health. Obtain, if possible, a reliable laboratory examination of suspicious or sickly specimens, then follow the best sanitary method of rearing most adaptable to your conditions, equipment and environment.

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